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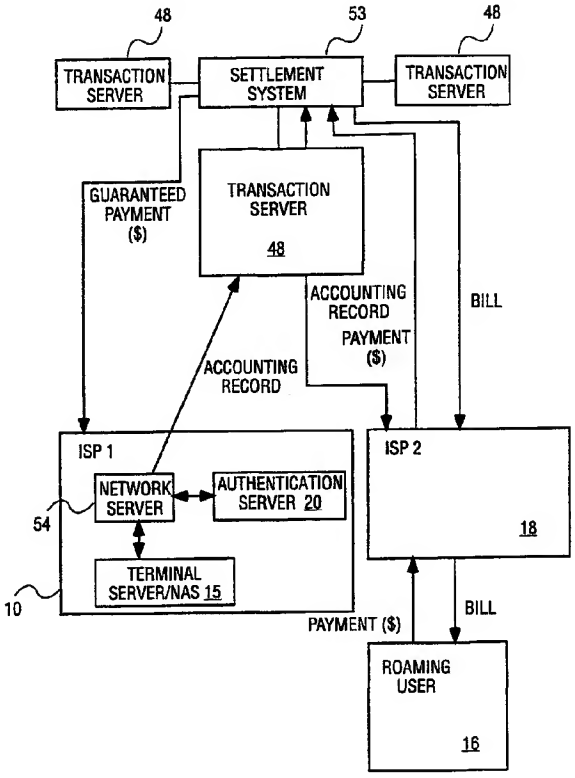
(54) Title: METHOD AND SYSTEM TO NORMALIZE TRANSACTION DATA PERTAINING TO ACCESSES TO A SERVICE PROVIDED VIA A PLURALITY OF SERVICE PROVIDERS



(57) Abstract: A method of normalizing transaction data pertaining to an access to a service provided by a service provider normalizes transaction data retrieved from a number of transaction data sources in the form of transaction servers (48) that serve to broker access authorization between a first service provider (10) and a second service provider (18). A dedicated load process is instantiated at a transaction broker (34) for each of the multiple transaction data sources (48). Transaction data is retrieved from the multiple transaction data sources (48), each dedicated load process operating to load transaction data from an associated transaction data source (48). By having each dedicated load process servicing an associated transaction data source (48), the provision of normalized transaction data in a near real-time manner may be facilitated.

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METHOD AND SYSTEM TO NORMALIZE TRANSACTION DATA PERTAINING TO ACCESSES TO A SERVICE PROVIDED VIA A PLURALITY OF SERVICE PROVIDERS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional application no. 60/185,180, filed February 25, 2000.

FIELD OF THE INVENTION

The present invention relates generally to the field of multi-party service access and, more specifically, to the brokering and settlement of service access transactions in a multi-party environment, involving multiple service providers and multiple service customers, such as a roaming service access environment.

BACKGROUND OF THE INVENTION

Due to the increasing globalization of economies, the need to provide communications between geographically disbursed persons and facilities has increased. For example, a particular business may have facilities located across multiple countries and continents. A further result of increased globalization has been an increase in business travel. The increasing dependence of corporations and persons on Internet-based communications has furthermore made it desirable that mobile workers (so-called "road warriors") be able to access Internet-based and wireless communications as they travel worldwide. Services that facilitate communications to such mobile persons are commonly referred to as "roaming services". Considering Internet-based communications as an example, in order to meet the needs of mobile customers, Internet Service Providers (ISPs) have begun to offer local-call access to the Internet from various locations world-wide, such a service being termed a "roaming" Internet access solution. The requirement for a roaming solution arises primarily because ISPs tend to specialize by geographic area, causing gaps in service coverage. The expansion of network infrastructure, network management and continuous upgrades to meet required reliability and performance standards all place tremendous capital and time burdens on ISPs. For these reason, many ISPs only locate Points of Presence (POPs) in a limited geographic area.

For the reasons set out above, the ability for ISPs to offer Internet roaming solutions, especially to business customers, is becoming increasingly important as many businesses utilize Internet-based communications to replace traditional remote access solutions for their telecommuters and mobile work forces.

In order to provide Internet roaming solutions, some ISPs have begun to share network infrastructure to gain additional geographic reach. This infrastructure sharing might take the form of an agreement to allow users of one ISP to gain Internet access through another ISP's network. **Figure** 1 is a block diagram illustrating such a prior art arrangement whereby a first ISP 10, within a first geographic area 12, facilitates access to a network via a POP 14 to a roaming user 16. The roaming user 16 is a subscriber to a second ISP 18, but through an agreement between the ISPs 10 and 18 obtains service access through the POP 14.

The bilateral agreement between the ISPs 10 and 18 illustrated in **Figure 1** may require building user names and passwords into authentication databases for both the ISPs 10 and 18. Alternatively, an authorization server 20 of the ISP 10 may, upon receiving an access request to the POP 14 from the roaming user 16, initiate a direct authorization procedure with an authorization server 22 of the ISP 18. Both options involve a complex technical implementation in order for one provider to "buy" a small amount of service access time through another provider. The management of such relationships may also be difficult and cost ineffective. For example, consider that the roaming user 16 will pay the ISP 18 for the service access facilitated by the ISP 10. The ISP 18 then is shown to make a payment to the ISP 10.

To summarize, a number of problems are encountered when ISPs attempt to share network infrastructure. Firstly, the creation of a secure authentication scheme over a public access network may be difficult. Secondly, managing accounting information and sharing costs may be complex. Thirdly, providing sufficient scalability may be challenging. These problems become exasperated as ISPs attempt to provide global coverage, requiring that a particular ISP enter into relationships with a large number of other ISPs. This arrangement does not scale well, and the complexity of managing these relationships significantly increase each time a new partnership is established.

SUMMARY OF THE INVENTION

According to the invention, there is provided a method of normalizing transaction data pertaining to access to a service provided via a plurality of service providers, the transaction data being retrieved from a plurality of transaction data sources. A dedicated load process is instantiated at a transaction broker for each of the plurality of transaction data sources. Transaction data is retrieved from the plurality of transaction data sources, each dedicated load process operating to load transaction data from an associated transaction data source.

Other features of the present invention will be apparent from the accompanying drawings and from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figure 1 is a block diagram illustrating a prior art method for service providers to exchange authentication, usage and accounting information.

Figure 2 is a block diagram of a multi-party service access environment, according to an exemplary embodiment of the present invention, that includes a number of service providers, an access broker system and multiple customers.

Figures 3 and **4** are block diagrams illustrating operation of an access broker system to provide roaming Internet access, according to an exemplary embodiment of the present invention.

Figure 5 is a diagrammatic representation of the physical architectural of an access broker system, according to an exemplary embodiment of the present invention.

Figure 6A is a block diagram illustrating an architecture of a settlement system, according to an exemplary embodiment of the present invention.

Figure 6B is a block diagram illustrating an exemplary multi-tiered customer structure.

Figure 7 is a block diagram illustrating a data model, according to an exemplary embodiment of the present invention.

Figure 8 is a flow chart providing a high-level view of a method, according to an exemplary embodiment of the present invention, of facilitating a financial settlement of service access transactions between multiple parties.

Figure 9 is a diagrammatic representation of data load, normalization and summarization operations, according to an exemplary embodiment of the present invention.

Figure 10 is a flow chart illustrating a method, according to an exemplary embodiment of the present invention, of loading, normalizing and summarizing service access transaction data for service access transactions between multiple parties.

Figure 11 is a flow chart illustrating a method, according to an exemplary embodiment of the present invention, of normalizing service access transaction data.

Figure 12 is a flow chart illustrating a method, according to an exemplary embodiment of the present invention, of resolving buy and sell rates for a service access transaction.

Figure 13A is a flow chart illustrating a method, according to an exemplary embodiment of the present invention, of summarizing service access transaction information.

Figure 13B is a flow chart illustrating a cycle summary process, according to an exemplary embodiment of the present invention.

Figures 14A - 14B are object diagrams illustrating exemplary settlement classes.

Figure 15 is a block diagram illustrating the various exemplary threads that may be started by a normalization class.

Figures 16A - 16B illustrate a state transition diagram that describes various exemplary states of the threads illustrated in Figure 15.

Figure 17 is a representation of an exemplary contract screen that may be generated by a data management application.

Figure 18 illustrates an exemplary billing statement that may be generated by a settlement system.

Figure 19 illustrates an exemplary client usage report that may be generated by the access broker system.

Figure 20 illustrates an exemplary service provider report that may be automatically generated and presented to a service provider by an access broker system.

Figure 21 illustrates an exemplary call detail report that may provide a view of CDR records in comma-delimited format.

Figure 22 is a diagrammatic representation of a machine, in the exemplary form of a computer system, within which a set of instructions to perform an exemplary embodiment of the invention may be executed.

DETAILED DESCRIPTION

A method and system to normalize transaction data pertaining to accesses to a service provided via a plurality of service providers are described. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be evident, however, to one skilled in the art that the present invention may be practiced without these specific details.

Terminology

For the purposes of the present specification, the term "service access transaction" should be taken to include a transaction between a service customer and a service provider for access to a service. An example of such a service may be access to any communications network via any medium or protocol. For example, the communications networks may comprise packet-switched networks, circuit-switched networks, cable networks, satellite networks, terrestrial networks, wired networks, or wireless networks. The term "service access transaction", however, is not limited to a network access transaction, and encompasses a transaction pertaining to access to any one of a number of other services such as content, commerce and communications services.

For the purposes of the present specification, the term "customer" shall be taken to include any entity involved in the purchase and/or consumption of service access, regardless of whether the service access is performed by the customer or not. For example, a "customer" may be an end-user consumer that actually utilizes the service access, or a corporate entity to which such an end-user belongs, an Internet service provider, an Internet carrier, a reseller, or a channel.

Overview

The present invention discloses a third-party access broker and settlement system for service access (e.g., Internet access, content access, commerce access, or communications access) services that enable a service provider (e.g., an ISP, a

wireless service provider, a VPN service provider, a content distribution service provider, an e-commerce service provider or an application service provider) to offer provider independent service access to multiple services in a geographically dispersed manner. One embodiment of the present invention provides a method for service providers to exchange authentication, usage and accounting information in a secure, standardized manner without the need to establish multiple bilateral relationships with other service providers, as described above with reference to **Figure 1**. The present invention also provides a "clearing house" function to facilitate the settlement of service usages between service providers and to process billing information in a manner compatible with the existing billing mechanisms of service providers.

Figure 2 is a block diagram of an exemplary multi-party service access environment 30, in the exemplary form of a network access environment, that includes a number of service providers 32, an access broker system 34, according to an exemplary embodiment of the present invention, and multiple customers (or consumers) 36. At a high level, the service providers 32 have service (e.g., access, content, e-commerce services etc.) capacity that is sold, via the access broker system 34, to the multiple customers 36. Accordingly, the access broker system 34 may be regarded as purchasing service capacity (e.g., service access), which is then resold to the customers 36. While the service to which access is provided below is network access, it will be appreciated that access is described below as an exemplary service. In the exemplary embodiment, the service providers 32 may include any communication network service providers, such as ISPs 38 (e.g., UUNet Technologies, Genuity, CompuServe Network Services, EQUANT, Hong Kong Telecom, etc.), wireless access providers 40 (e.g., Verizon, Sprint, Pacific Bell), content distribution providers 42 and e-commerce providers 44. The service providers 32 may, however, include any number or type of service providers providing any number of services (e.g., access, content, communications or e-commerce services, to name but a few).

The access broker system 34, according to an exemplary embodiment of the present invention, is shown to include a number of components. A connection application 46 is a client application, typically installed on a service access device

(e.g., a computer system) of a customer 36 that facilitates convenient access to a communications network. In one embodiment, the connection application 46 comprises a dialer that provides a simple point-and-click interface for dialing into a worldwide connection network of the access broker system 34. To this end, the connection application 46 may store multiple phone numbers for multiple ISPs worldwide with potentially different setup and dial-up scripting information.

Transaction servers 48 provide trusted third-party functionality of routing and logging user identification information, authorization responses and usage and accounting information, as will be described in detail below.

Network servers 50 are installed on a "remote" ISP allowing its POPs to be utilized by roaming users. Roaming servers 52 reside at a "home" ISP to allow users access to a roaming network. It should be noted that the transaction servers 48 operate to route messages between the network and roaming servers 50 and 52.

A settlement system 53, according to an exemplary embodiment of the present invention, performs financial settlement of service access transactions between the service providers 32 and the customers 36.

The access broker system 34 is also shown to include Service Quality Monitor 55 (SQM) that facilitates the collection and analysis of quality of service (QoS) information for services provided to customers 36 and a phonebook management system 56 that facilitates management of multiple connection applications 46 utilized by customers 36.

The settlement system 53, the SQM 55 and the phonebook management system 56 interface directly with central settlement database.

The network and roaming servers 50 and 52 do not interface with the central settlement database. The transaction servers 48 are accessed by the settlement system 53 to load transaction data. Functioning of the settlement system 53, and an included flexible pricing engine 58, are described in detail below. The settlement system 53 may be viewed as including the following high-level components:

1. Settlement back-end applications;
2. Settlement front-end applications;
3. Data aggregation and reporting applications; and
4. System interfaces.

Turning now to the customers 36, **Figure 2** illustrates a multi-tier customer structure, whereby the access broker system 34 may interact with customers 36 operating according to a variety of business plans and needs. At one end of the spectrum, a customer 36 may comprise an individual end-user that subscribes to a roaming system facilitated via the access broker system 34. Alternatively, a customer 36 in the form of a corporate customer (e.g., a corporation or business) 62 may operate as a customer of the access broker system 34 to purchase roaming Internet access for employees of the corporation.

A customer 36 may also comprise an ISP customer 64 that purchases roaming Internet access for resale to its customers (e.g., end-users 60 and corporate customers 62). A customer 36 may also operate as a solution partner or reseller 64 that markets and resells roaming Internet access brokered by the access broker system 34 to end-users 60, corporate customers 62 or ISP customers 64.

The customers 36 may also include parties regarded as Internet Carriers 66 (e.g., IXCs, RBOs, CLECs, ILECs and ISPs). It will be appreciated that any of the entities comprising the customers 36, as discussed above, may operate to purchase service access from the access broker system 34 either for use or resale.

Roaming Service Access

Figures 3 and **4** are block diagrams illustrating how the access broker system 34 operates to provide roaming Internet access, according to one embodiment of the present invention. This example is provided merely by way of illustration, and it will be appreciated that the settlement system 53 described in more detail below is not limited to Internet access, but may be applied to the settlement of any service (e.g., network, content, or e-commerce service) access transactions.

Referring specifically to **Figure 3**, when the roaming user 16, shown to be a subscriber to a "home" ISP 18, connects to a remote ISP 10 that provides a local POP 14 within a specific geographic area 12, the roaming user 16 inputs the same user name 70 and password 72 (i.e., authentication information) used when connecting via a POP of the "home" ISP 18. A slight modification to the regular user name 70 identifies the roaming user as "visiting" and thus requiring remote authentication.

This authentication information is collected by a terminal server or a network authorization server (NAS) 15 and is sent to an authorization server 20 of the remote ISP 10. In the normal course of operations, a network authorization server (NAS) 15 at the remote ISP 10 would reject the supplied authentication information. However, as illustrated in **Figure 3**, the network server 54 intercepts the authentication information to facilitate recognition of this authentication information as a roaming user authentication request.

The authorization server 20, in conjunction with the network server 54, parses the received authentication information to determine a roaming domain name and prefix associated with the roaming user. Should such a domain name or prefix be present, the user's authentication information is encrypted using an algorithm from RSA Data Securities, and sent from the network server 54 to a transaction server 48 via secure socket layer (SSL).

The transaction server 48 performs an Internet Protocol (IP) look-up and routes the authentication request to an appropriate home ISP 18. More specifically, the transaction server 48 receives an encrypted authentication request from the network server 54 at the remote ISP 10, and decrypts this request. The transaction server 48 then determines the "home" ISP 18 by matching the roaming domain name of the desired home ISP 18 against a current list of participant domain names and IP addresses. If the match is successful, the authentication request is encrypted and sent via SSL to a roaming server 52 that resides at the home ISP 18. In the event that the identified roaming server 52 does not respond within a specific period, the transaction server 48 will attempt to contact an alternative roaming server 52 at the ISP of the relevant domain.

The roaming server 52 at the "home" ISP 18 then decrypts the authentication request sent from the transaction server 48, and submits the authentication request to the "home" ISP's regular authorization server 22 as if it were a terminal server or NAS 15 owned by the home ISP 18. The "home" ISP 18 authorization server 22 responds to the request by providing an "access permitted" or an "access denied" response based on the validity of the user name and password included within the authentication request. The response from the authorization server 22 is received by the roaming server 52, encrypted, and sent back to the transaction server 48.

The transaction server 48 receives the encrypted response, identifies the remote ISP 10, encrypts the response, and returns the authorization message to the remote ISP 10.

Figure 4 is a block diagram illustrating the accounting and settlement procedures, according to an exemplary embodiment of the present invention, which may be facilitated by the access broker system 34.

When a roaming user 16 connects and disconnects from remote ISP 10, the terminal server (or NAS) 15 managing the session generates the accounting information and sends this information to the authorization server 20. The authorization server 20, in conjunction with the network server 54, parses the accounting information to determine a roaming domain name and prefix associated with the roaming user. Should such a domain name or prefix be present, the user's accounting information is encrypted using an algorithm from RSA Data Securities, and sent from the network server 54 to a transaction server 48 via secure socket layer (SSL). The network server 54 ensures the accounting records are generated for the roaming user 16.

An accounting record is then communicated, in near real-time, to the transaction server 48 utilizing SSL, where the accounting records are stored in the database. These accounting records are further processed by the settlement system 53 to produce Call Detail Records (CDRs). Each call detail record provides detailed usage reporting regarding the identity of the roaming user 16, when the relevant service access occurred, the location of the service access, the length and cost of each service access session, and the time of the service access (e.g., local or GMT time).

Multiple transaction servers 48 provide accounting records to the settlement system 53, which utilizes these records to generate bills (or invoices) to customers 36, and also to make payments to service providers 32.

In summary, the settlement system 53 generates bills and distributes them among customers 36 so that they can make payments to the settlement system 53, and in turn bill their customers if appropriate. Similarly, the settlement system 53 makes payments to the remote (or visitor) ISPs or other service providers 32 for accrued access time used by roaming users. The settlement system 53 may further guarantee payment for authorized use by a roaming user. An operator of the

settlement system 53 thus acts as a secure, trusted entity providing a mechanism for facilitating financial settlement of service access transactions between multiple parties. The settlement system 53 implements numerous automatic functions and operations so as to enable the settlement in a timely, automated and convenient manner. Further details regarding the operation of the settlement system to facilitate such settlement or service access transactions will be described in detail below.

Physical Architecture

Figure 5 is a diagrammatic representation of the physical architecture of an access broker system 34, according to an exemplary embodiment of the present invention. Multiple transaction servers 48 are shown to reside on one or more server machines 80, each of which has access to an associated database 82. A web server and phonebook server reside on a server machine 84, and are accessible by remote internal users 86 and customers 36. The web server operates to generate and deliver web pages (e.g., HTML documents) to both the remote internal users 86 and the customers 36, examples of such web pages being provided below. The phonebook server (part of the phonebook management system 56) operates to maintain and update the electronic phonebooks of customers 36, and accordingly both receives and publishes updates to and from service providers 32, and publishes such updates to customers 36.

The settlement system 53, and a collection of internal users 88 are shown to reside behind a firewall 90. Specifically, the settlement system 53 is hosted on one or more server machines 92 that have access to a central database 94.

Overview - Settlement System

Figure 6A is a block diagram illustrating the architecture of a settlement system 53, according to an exemplary embodiment of the present invention. As discussed above, the settlement system 53 comprises back-end applications 100, front-end applications 102, data aggregation and reporting applications 104 and system interfaces 106.

The back-end (or server-side) applications 100 are shown to include a settlement application 108 that determines a transaction price, updates account

balances for all parties involved in a transaction, and verifies credit limits, a billing application 110 that closes an accounting cycle, applies periodical fees, generates billing reports, including invoices and call detail records (CDRs), and publishes billing reports to the web, and an auditing application 112 that verifies business rules and structural integrity of the central database 94. The settlement application 108 is shown to embody the flexible pricing engine 58.

The settlement application 108 is responsible for normalization, summarization and verification functions. The normalization function includes converting accounting data received from multiple transaction servers 48 into a single format CDR to be used for billing, identifying parties involved in a service access transaction, and defining the price that the access broker system 34 owes to a provider 32 and the price that a customer 36 owes to the access broker system 34 for a particular service access transaction.

The summarization function involves applying buy and sell prices to account balances for all parties involved in a service access transaction, and updating appropriate account balances. The verification function includes the verification of credit limits.

The settlement system 53 operates to provide near real-time settlement of service access transactions to allow for the near real-time revenue and account tracking by both providers 32 and customers 36.

As mentioned above, the settlement system 53 includes the flexible pricing engine 58 that supports a flexible pricing model, which has the following features:

1. A variety of data structures dependent on, for example, the customer 36, the service provider 32, the location of the service access, the type of service access (e.g., dialup modem, ISDN, DSL), or usage accumulated during a particular cycle for a particular customer 36.
2. Any combination of (a) usage (e.g., a function of rate and session length); (b) transactional (per transaction); and (c) subscription-based or flat pricing (e.g., one price for all usage during a billing cycle for a customer 36 or one or more prices per each user for a customer during a billing cycle).

3. Offered discounts and promotions.
4. A variety of fees, such as start-up fees, monthly fees and minimum monthly commitments.
5. Multi-tiered pricing schemes, or intra-provider roaming, where buy and sell rates for a particular location depend on the provider 32 and whether the service user/customer 36 of the service access belongs to a further customer 36, its affiliate, or their customer.

The flexible pricing engine 58 is database-driven, thus allowing implementation of new pricing models by loading the appropriate plan into pricing tables (not shown) maintained within the central database 94.

More specifically, the flexible pricing engine 58 facilitates a multi-tiered pricing model, whereby rates for a single service access transaction may be applied across multiple tiers of consumer (or customer) according to multiple criteria. These criteria may include, *inter alia*, any combination of usage (e.g., accumulated usage time or value total) pricing and transactional (e.g., an accumulated total number of transactions) pricing.

Figure 6B is a diagrammatic representation of a multi-tier customer structure, whereby a reseller 64 sells service access to a corporate customer 62 then in turn facilitates service access by an end user 60. It will be appreciated that the exemplary multi-tiered customer structure is purely exemplary, and any combination and arrangement of customer structure may be accommodated by the flexible pricing model. In the example, the end user 60 is shown to be provided with service access through the corporate customer 62 and through the reseller 64, with pricing for that service access being percolated down through the tiers of the consumer structure. Specifically, for each customer in such a multi-tiered customer structure, a separate and distinct pricing model 65 may be defined and applied to determine pricing for a single service access involving the relevant customer. Merely for example, a single service access by the end-user 60 may have pricing implications for both the corporate customer 62 and the reseller 64, and the flexible pricing engine 58, according to an exemplary embodiment of the present invention, allows an

appropriate record for that single service access to be generated for each of the consumers in the multi-tiered consumer structure according to criteria and specifications unique to each such customer.

Exemplary criteria that may be embodied within a pricing model 65 applicable to a particular consumer may be any combination of usage and transaction pricing. For example, when an accumulated usage or transaction total for a particular reseller 64, which may provide access to any number of further levels of customer, reaches a predetermined threshold, the pricing applied for service access may change. Specifically, volume discounts based on usage or transaction totals may apply. In this way, a customer on a particular tier of a multi-tiered customer structure may obtain the benefit of service accesses by customers below the relevant customer, and obtain favorable pricing based on, for example, volumes of service access usage or service access transactions that the reseller customer purchases from the access broker system 34.

Similarly, usage and transaction totals may be maintained for the corporate customer 62 for accesses to the network by all end users 60 (e.g., employees) associated with the corporate customer 62, so as to enable the corporate customer 62 to obtain pricing benefits associated with the amount of service access usage, and a number of service access transactions, by employees of the relevant corporate consumer 62.

Other pricing criteria that may be included within a pricing model 65 applicable to a specific customer include:

1. The identity of the entity actually performing the service access (e.g., a service access by a particular corporation may be priced at a specific rate);
2. The network location being accessed;
3. The time of day at which the service access occurs;
4. The day of the week at which the service access occurs;
5. Discounts and promotions applicable to the particular consumer;
6. Type of service access;
7. Type of service; and/or
8. Various customer and end-user fees and commitments.

A respective pricing model 65 may also specify certain subscription, or flat rate pricing to be applied to an appropriate customer.

In summary, by providing a multi-tiered, flexible pricing model, the pricing engine 58 allows a single service access transaction, by any customer within a multi-tiered customer structure, to be reflected in the account balances for multiple customers according to a dedicated pricing model 65 for each of those respective customers.

Returning now to **Figure 6A** and the front-end applications 102, a data management application 114 is utilized by various functional units of the access broker to perform business processes and to view data for information purposes. To this end, data management application 114 may provide various user interfaces to manage information related to customers 36 and access points, and to perform accounting and administrative functions.

An order processing application 116 provides user interfaces to customers 36 (e.g., solution partners 64 or resellers) to place orders for new corporate customers.

The data aggregation and reporting applications 104 include several processes that summarize data on a daily or monthly basis to enable operational, functional and network load reporting.

The system interfaces 106 have a loader application that includes a transaction server loader 118, a provider loader 120 and accounting system interfaces (not shown). Dealing first with the transaction server loader 118, a "data loader" component pulls accounting records from the databases 82 of the respective transaction servers 48 to the central database 94 for processing. Multiple transaction server loaders 118 may be implemented as distributed database links, and the accounting records are pulled via the loaders 118 in near real-time.

A provider loader 120 receives call detail records (CDRs) from providers 32 in a batch form. This CDR data is pre-processed by a provider loader 120, which may retrieve the data from an appropriate FTP site and convert it into the same format as the data received from the transaction servers 48.

Overview - Data Model

Figure 7 is a block diagram illustrating an exemplary data model including customer tables 132, access point tables 134, pricing tables 136, CDR tables 138 and accounting tables 140. Further details regarding these exemplary tables will be provided below.

Overview - Processes

Figure 8 is a flow chart providing a high-level view of a method 150, according to an exemplary embodiment of the present invention, of facilitating financial settlement of service access transactions between multiple parties. The method 150 commences at block 152 with a data load and retrieval operation, followed by a data normalization operation at block 154. A data summarization operation is performed at block 156. Various credit limits are verified at block 158, whereafter invoicing of customers 36 is performed at block 160. Further details regarding each of the operations described above with reference to blocks 152 - 160 shall be provided below.

Figure 9 is a diagrammatic representation of the data load and retrieve operation indicated at block 152 in **Figure 8**, the data normalization operation indicated at block 154 and the data summarization operation indicated at block 156. Specifically, dedicated transaction server loaders 118, in the exemplary form of loader threads, are shown to retrieve raw call detail (or accounting) records (CDRs) from each of the respective databases 82 maintained by the transaction servers 48, and to include such records within a raw call detail records (CDR) table 170. Similarly, dedicated provider loaders 120, in the exemplary form of loader threads, retrieve raw call detail records (CDRs) from one or more service providers 32 in batch form for inclusion within the raw CDR table 170.

A normalization process 172 then converts the raw call detail records retrieved from the raw CDR table 170 into normalized call detail records to be stored in a CDR table 174, while a summarization process 176 summarizes the normalized call detail records into summarized records for storage in an account cycle table 178 and a user account cycle table 179.

It should be noted that the load, normalization and summarization operations are performed in near real-time, which is facilitated by multithreaded processes. Specifically, each thread makes a connection to an appropriate database 82. Accordingly, the transaction server loaders 118, the provider loaders 120, and normalization process 172 are shown to include multiple threads to provide the near real-time capabilities.

Methodology - Load, Normalization and Summarization

Figure 10 is a flow chart illustrating a method 180, according to an exemplary embodiment of the present invention, of loading, normalizing and summarizing service access transaction data for service access transactions between multiple parties. The method 180 is performed, at least in part, by the settlement application 108 of the settlement system 53, illustrated in **Figure 6**.

The method 180 commences with the loading of accounting records from the respective databases 82 of the transaction servers 48, in the manner described above. Specifically, each server 48 may, in one embodiment, generate three types of records for each roaming user session, namely: (1) an authentication record; (2) a session start accounting record; and (3) a session end accounting record. In one embodiment, only the session end accounting record is retrieved via the transaction server loaders 118, and utilized by the settlement system 53, as such records contain all required information concerning the duration of a particular service access session.

At block 184, the provider loaders 120 similarly retrieve call detail records from relevant service providers 32. The provider loaders 120 load and pre-process call detail records received from the providers 32, including decrypting such records, parsing and loading the records into appropriate tables, and converting the records into a standard format for inclusion within the raw CDR table 170.

A normalization operation is performed at block 186 by a normalization process 172, as illustrated in **Figure 9**. The normalization operation includes a number of functions, which will now be individually described.

At block 202, a filtering process eliminates call detail records that are considered to be invalid from further processing and billing. For example, the following call detail records may be considered invalid:

1. Records indicating a session time that exceed a predetermined maximum (e.g., 100 hours);
2. Call records that indicate a specified session ID indicating the record was not as a result of a process of interest (e.g., an administrative session);
3. A call record where the domain name of the record is not of interest (e.g., where domain name indicates that the NOC probed the network);
4. Call records that indicate a negative session time (e.g., as a result of faulty network authorization servers); and
5. Call records that indicate a common customer and provider.

At block 204, a duplicate detection function identifies duplicate accounting records, and eliminates them from further processing. Such duplicate records may be included within the raw CDR table 170 as network authorization servers (NAS's) 15 may resend accounting records if the response from a destination is not received within a predetermined time interval.

At block 206, a transaction normalization function is performed, followed by a transaction summarization function at block 208. Further details regarding the transaction normalization and transaction summarization functions are described below with reference to **Figures 11 - 13**.

At block 210, a credit limit verification function retrieves credit limit and credit limit threshold information for a given customer from the central database 94, verifies customer account balances against the credit limit and credit threshold information, and sends an e-mail to an accounting contact if the credit limit or credit threshold is exceeded.

Returning to the transaction normalization at block 206, **Figure 11** is a flow chart illustrating a method 206, according to an exemplary embodiment of the present invention, of normalizing service access transaction data. The method 206 is performed by the normalization process 172. At block 212, raw transaction information (e.g., CDR records that are flagged as having "raw" status within the raw CDR table) 170 is retrieved.

At block 214, the relevant customer identity for a specific call detail record is resolved. Specifically, a stored procedure "resolve_customer" parses user login string to extract a domain name. The domain name may then be validated against a "customer_domain" table, which results in a "customer_id". If a domain cannot be resolved, an exception is generated.

At block 216, the call location is resolved. Call locations are represented in accounting records in a variety of ways, and specific business rules are defined to determine the location type for a given call detail record. Specifically, the resolution of the call location, at block 218, may determine a location type based on a provider identifier that identifies which field in a call detail record contains a location value. At block 220, records are selected from a "location" table 221 based on a provider identifier, location type and location value, and the location identifier and location group identifier are determined.

At block 222, a contract and pricing plan are resolved. Specifically, this involves the three operations indicated at blocks 224-228. At block 224, a determination is made as to whether a specific customer has a reseller (or parent), for which the service access is purchased. At block 226, product is determined based on the type of transaction (e.g., for example, roaming, telephony, e-commerce). At block 228, a contract and pricing plan are selected from a "contract" table 229 based on a customer identifier, a location identifier, a reseller identifier (if any) and a product identifier.

At block 230, a buy rate and a sell rate are resolved. Further details regarding this operation are described below with respect to **Figure 12**.

At block 234, the normalization is completed. Specifically, the normalization process 172 stores the results of the process in the normalized call detail records (CDR) table 174. The status of a call detail record within the raw CDR table 170 may be changed to "normalized", billing event records may be included within a "billing_event" table (not shown), one billing event record being for the relevant customer 36 and the other being for the relevant provider 32. The normalized call detail record is then stored in the CDR table 174.

Further details regarding the resolution of the buy and sell rates at block 230 will now be described. **Figure 12** is a flow chart illustrating an exemplary method

230 of resolving buy and sell rates for a service access transaction. At block 240, a buy rate is selected from a buy_rate table 241of the pricing tables 136, shown in **Figure 7**, based on a location group identifier, access type (e.g., modem, ISDN, DSL, toll free etc.) and contract identifier.

At block 242, a determination is made as to whether there is an active promotion for a given contract identifier.

At block 244, a usage rate is selected from a rate usage table 245 of the pricing tables 136 based on a pricing plan identifier, a location group identifier, a transaction date and total usage for a customer (e.g., an end-user, corporation or reseller) for a current accounting cycle. The total usage parameter may, in one embodiment, only be used where usage-based rating conditions are included within a rate.

At block 246, a promotional usage discount, from a promotion record, is applied if it is determined at block 242 that a promotion is active.

At block 248, a reseller usage discount may be applied from a contract record, if the customer is determined to be a customer of a reseller to which such a discount is provided.

At block 250, a transaction rate is determined from a rate transaction table 251 of the pricing tables 136 utilizing the same criteria that were utilized at block 244 to select the usage rate.

At block 252, a promotion transaction discount is applied from the promotion record, where it is determined at block 242 that there is active promotion.

Accordingly, from blocks 244 - 252, a usage rate, less a usage discount and a transaction rate, less a transaction discount are determined. At block 254, a sell rate may be computed by adding the discounted usage and transaction rates, whereafter the computed sell rate may be rounded to the nearest cent.

At block 256, if it is determined that the sell rate is less than the buy rate, an exception may be raised and accounting may be notified.

It should furthermore be noted that the selections of the usage and transactional rates at blocks 244 and 250 include verification of the following conditions:

1. A transaction date is checked against rate start/end dates and day week;

2. A transaction time is checked against the rate start/end times of a particular day; and
3. Usage limits (start/end) are checked against respective usage counters in user account and account cycles incremented with the transaction duration for the end of user level conditions. The level of a user limit condition is specified in a rate record contained within the rate usage and rate transaction tables of the pricing tables 136. If a transaction causes the accumulated usage to exceed a specified usage limit, two sets of rates may be applied (e.g., the record may be reported as two call detail records in a call detail record report).

In one exemplary embodiment, a rate stored and a rate record of the rate usage or rate transaction table may include three components, namely:

1. A fixed rate, that is the fixed amount paid for a service access session;
2. A scaled rate that is a usage-based rate; and
3. A free quantity that is an amount of time that is not included in the usage charges for each service access transaction. A rate (either a usage or transaction rate) may be calculated as: *rate = fixed rate + scaled rate *(session duration - free quantity).*

Further details shall now be provided regarding the transaction summarization operation of block 208, shown in **Figure 10. Figure 13A** is a flow chart illustrating a method 208, according to an exemplary embodiment of the present invention, of summarizing service access transaction information. At block 260, an account cycle record is obtained from account cycle table 178 of the accounting tables 140 for a given customer (or location) identifier and product identifier, where a transaction date is within cycle start and end dates. If an account_ cycle record does not exist for a given customer identifier, reseller identifier and product identifier, such a record is then created within the account cycle table 178 at block 262.

At block 264, a customer account cycle record within the customer account cycle table 179 is updated by incrementing the following account cycle balances maintained within an appropriate record:

1. Usage accumulated/value;
2. Usage accumulated/time;
3. Number of transactions;
4. Total service charges; and
5. Usage counters to support customer level usage-based pricing conditions.

An account balance is further calculated utilizing a formula

based on a value of several balances from a customer account cycle. The account balance is recalculated every time an account cycle record is updated.

At block 266, an end-user customer transaction is updated by incrementing usage accumulated/value, usage accumulated/time and user counters that support end-user customer level usage pricing conditions.

At block 268, a provider account cycle is updated by incrementing usage provided/value and usage provided/time balances, and by decrementing a current services charge balance and an account balance.

It should furthermore be noted that, for different customer types (e.g., resellers, ISPs, consumers and end-users), different balance types may be maintained to support a pricing model 65 applicable to the particular consumer. Examples of such balances for a corporate consumer 62 and an end-user are listed below:

Exemplary Corporate Consumer Balances:

usage used value
usage used time
number of transactions
transactional value
usage provided value
usage provided time
startup fees
cycle fees
user cycle fees

user cycle flat fees
commitment penalty
credit (multiple balances by type)
service charges
previous balance
account balance
payment payables
payment receivables
usage counter 1
usage counter 2

Exemplary End-User Balances;
usage used value
usage used time
number of transactions
transactional value
usage counter 1
usage counter 2

Returning to the method 180 illustrated in **Figure 10**, following the normalization operation at block 186, records from the raw CDR table 170 that are older than a predetermined time period (e.g., two hours) and which have a status of "normalized", "filtered", "duplicate" or "exception" are deleted to prune raw CDR table 170.

At block 190, a cycle summary (or cycle close) is run at the end of a predetermined time period (e.g., daily, weekly or monthly). Specifically, the billing application 110 supports customer specific billing schedules, which facilitates the billing of different customers on different dates. A specified customer cycle close time and/or day may be stored in a customer_billing_information table (not shown). A cycle close summarizes customer and user account cycle and closes customer account cycle.

Figure 13B is a flow chart illustrating further details of a cycle summary process 190, according to an exemplary embodiment of the present invention. The cycle summary process 190 retrieves account cycles from the account cycle table 178 for a particular customer, then proceeds to block 450 and retrieves a contract and pricing plan for the specific customer from a contract table 229, based on a customer identifier, a location identifier, a reseller identifier (if any) and a product identifier.

At block 452, monthly flat fees may be summarized.

This involves the selection of all records from a flat fee table 243, included within the pricing tables 136, for a particular plan identifier associated with the relevant customer.

At block 454, if the plan includes a start-up fee, and the current cycle is the first cycle for a given customer, the start-up fee is calculated by resolving the rate identifier from the flat fee table 243 to the dollar amount, applying a fee discount from the flat fee table 243, and a reseller start-up fee discount (if any) from the contract table 229 to the fee amount. Thereafter, a billing record is inserted into a billing event table (not shown). Start-up fee and service charge balances are incremented.

At block 456, if the plan includes cycle (or monthly) fees, the cycle fee is calculated by resolving the rate identifier from the flat fee table 243 to the dollar amount and applying a fee discount from the flat fee table 243 to the fee amount. A billing record is then inserted into the billing event table (not shown) and cycle fee and service charge balances are incremented.

At block 458, if the plan includes user cycle fees, a number of end users for the cycle is calculated by calculating the number of records of the user account cycle for the relevant customer. A fee is calculated by resolving the rate identifier from the flat fee table 243 to the dollar amount, applying a fee discount from the flat fee table 243 to the fee amount, and multiplying it by the number of users, as previously calculated. A billing event record is then inserted into the billing event table (now shown), and user cycle fee and service charge balances are incremented.

At block 460, if the plan includes a flat rate plan user penalty fee, a number of end users for the cycle is calculated by calculating the number of records in the user account cycle for the relevant customer. A delta is calculated between an active

amount of users and a number of users contained in the contract record. A fee is calculated by resolving a rate identifier from the flat fee table 243, applying a fee discount from the flat fee table 243 to the fee amount, and multiplying this amount by the delta, as previously calculated. A billing event record is then inserted into the billing event table (not shown) and user cycle fee and service charge balances are incremented.

If a fee contained in the flat fee table 243 is not one of the fee types discussed above, an exception is raised.

Having then summarized the monthly flat fees at block 252, the process 190 progresses to block 462, where monthly commitments are summarized. Specifically, if a contract record is determined to contain a monthly commitment, a number of operations are performed. Specifically, if the monthly commitment is specified as a dollar amount, a verification operation is performed to determine whether total usage charges for the cycle are lower than the committed amount and, if so, a commitment penalty is set to the difference between the total usage charges and the committed amount.

If the commitment is specified as time, a verification operation is performed to determine whether total usage time for the cycle is lower than the committed time period. If so, a commitment penalty is calculated as the delta between the total usage time for the cycle and the commitment time, this delta being multiplied by the commitment penalty rate contained in the contract.

A billing event record is then inserted into the billing event table (not shown), and commitment penalty and service charge balances are incremented.

At block 464, the account cycle is closed.

Returning to **Figure 10**, at block 192, an invoice and CDR generation process is run after a cycle closes as part of the billing process. Specifically, at block 192, customer invoices are created billing reports are generated, and billing reports are published. It should be noted that the CDR generation at block 192 may also be performed in near real-time for customer access and viewing.

At block 194, a system audit process is performed. At block 196, a financial summary generation process is run periodically (e.g., daily) to support daily and monthly operational and finance reporting. The financial summary generation

process aggregates revenue by customer or provider, time of service access transaction occurrence, time within which the service access transaction is settled, country and region called. A number of summary tables may then be generated.

At block 198, a network data aggregation process summarizes the service access transaction data to support network load reporting, which includes information on total users, total number of connections, maximum simultaneous users and average session duration by country, city, state, transaction date and hour.

At block 200, a certificate management process manages certificates for the network servers 54 and the roaming servers 52 installed at various remote sites.

Settlement Classes

Exemplary classes that implement the settlement and billing functionality described above will now be described. Exemplary settlement classes may implement the following processes:

1. Load and normalization: The loading of accounting records from network transaction servers 48 and service providers 32, the conversion of accounting data received from the various providers 32 into a single format to be used for billing, determining the parties involved in a service access transaction (a customer and a provider), defining prices that the access broker system 34 owes to a provider 32 for a given transaction (i.e., a buy price) and the price that a customer owes to the access broker system 34 (i.e., the sell price).
2. Cycle summary: The determination of start-up and monthly fees, verifying minimum monthly commitments and applicable penalties, calculating account balances and closing an accounting cycle.
3. Invoicing: The generation of invoices and call detail records (CDRs).

The load, normalization and summarization processes are, in one embodiment, implemented in near real-time utilizing multi-threaded processes. Specifically, each thread makes an independent connection to a database. In one

embodiment, the load and normalization processes are controlled by a "dispatcher thread" 271. **Figures 14A - 14B** are object diagrams illustrating settlement classes, according to an exemplary embodiment of the present invention. In one embodiment, the dispatcher thread 271 is implemented by a normalize class 270. To this end, **Figure 15** is a block diagram illustrating various threads, according to an exemplary embodiment of the present invention, that may be started by the normalize class 270. The dispatcher thread 271 is responsible for controlling the normalization process. The normalize class 270 starts loader threads 118 and 120, as well as purge threads 272, and also polls the raw CDR table 170 for data.

As described above, and as will be apparent from **Figures 14A, 14B** and **15**, the normalize class 270 starts two types of loader threads, namely transaction server loader threads 118 and provider loader threads 120.

Specifically, the transaction server loader threads 118 are implemented by a transaction server loader class 117, shown in **Figure 14B**, to poll remote transaction servers 48 for raw data. It will be noted that a distinct transaction server loader thread 118 is implemented for each transaction server 48 from which raw data is obtained.

If data is available for processing at a specific transaction server 48, the respective loader thread 118 retrieves the raw data from the remote location, and loads the retrieved data into a transaction history table. The loader thread 118 loads a "STOP" accounting record in the raw CDR table 170, and notifies the normalize dispatcher thread 271 by generating an appropriate normalize message. The transaction server loader thread 118 then suspends further processing by "going to sleep" for a specified amount of time.

The provider loader threads 120 are implemented by a provider loader class 121 to poll remote provider servers (e.g., FTP servers) for data files. If data is available for processing from a specific provider, a respective provider loader thread 120 retrieves the data from the remote server via, for example, PGP. Again, a separate and dedicated provider loader thread 120 is instantiated for each service provider 32 from which data is retrieved. The loader thread 120 then loads the retrieved data into a history table, and loads a "STOP" accounting record into the raw CDR table 170, and notifies the normalize dispatcher thread 271 by generating a

normalized message. A provider loader thread 120 then suspends further processing by going to sleep for a specific amount of time.

Turning specifically to the normalize dispatcher thread 271, this thread is responsible for polling the raw CDR table 170 for data. When a raw row is available for processing, the dispatcher thread 271 attempts to locate a normalizer thread (of the normalization process 172 shown in **Figure 9**), to process the relevant row. If such a normalizer thread 273 is available, the normalize class 270 invokes the start () method on the relevant normalizer thread 273. On the other hand, should no normalizer threads 273 be available for processing a raw record, the normalize class 270 sleeps for a predetermined time period, whereafter an attempt is again made to locate a normalizer thread 273.

The normalizer thread class 274 operates to process raw CDR records and determines parties involved in a service access transaction (i.e., the customer and the provider), defines the price that the access broker system 34 owes to the provider 32 for a specific network transaction (i.e., the buy price) and the price that the customer owes to the access broker system 34 (i.e., the sell price). The normalizer thread class 274 further creates a CDR record, two billing event records and updates account_cycle records associated with a provider 32 and a customer 36 for a specific network transaction. The normalizer thread class 274 further resets the status of a raw CDR record to "normalize" and suspends further operation until the dispatcher thread 271 sends another raw CDR record for processing.

The Purge Raw CDR class 276 invokes the purge thread 272 to prune raw CDR table 170 at predetermined intervals. Specifically, the purge thread 272 purges raw CDR records from the table 170 that are older than a predetermined threshold (e.g., two hours), and that have the status of "normalized", "filtered", "duplicate" and "exception".

Figures 16A - 16B illustrate a state transition diagram 280, according to an exemplary embodiment of the present invention, that describes the various states of the threads shown in **Figure 15**. Specifically, **Figures 16A** and **16B** show a state space of a given context, the events that cause the transition from one state to another, and the actions that result. To summarize, a loader thread 118 checks for data availability on a remote transaction server 48. If data is available for processing, the loader

thread 118 downloads the data into the raw CDR table 170, and sends a "data loaded" message to the dispatcher thread 271, whereafter the loader thread 118 goes back to an idle state by suspending further operation by sleeping for a specified amount of time.

Upon receiving the "data loaded" message from the loader thread 118, the dispatcher thread 271 starts filtering the loaded records. The status of the raw CDR records that should be filtered out is changed to "filtered".

After filtering the raw CDR records, the dispatcher thread 271 detects and removes duplicates from the loaded records. The status of the duplicate raw CDR records is changed to "duplicate".

Records that are not filtered or removed as duplicate are marked as "RAW". The dispatcher thread 271 then retrieves the list of "RAW" records from the raw CDR table 170 and attempts to locate an available normalizer thread 273 for processing of each record.

In the event that the dispatcher thread 271 locates a normalizer thread 273, it sends a "normalize" message to that thread 273. If the dispatcher thread 271 cannot locate a normalizer thread 273 to process the "RAW" record, it suspends further operation by sleeping for a specific amount of time. The dispatcher thread 271 loops in the dispatching state until all "RAW" records in the raw CDR table 170 are dispatched for processing. After all the "RAW" records in the raw CDR table 170 are processed, the dispatcher thread 271 suspends further operation while sleeping for a specified amount of time.

A normalizer thread 273 receives the "normalize" message and processes the "RAW" record. The normalizer thread 273 then resets the status of the raw CDR record to "normalized" and suspends further operation until the dispatcher thread sends another raw CDR record for processing.

The purge thread 272 purges raw CDR rows older than two hours and with a status of "normalized", filtered, "duplicate", and "exception".

User Interfaces

Figure 17 is a representation of contract screen 300, according to an exemplary embodiment of the present invention, that may be generated by the data

management application 114 of the front-end applications 102, as illustrated in **Figure 6**. The contract screen 300 provides pricing management functionality by facilitating access to contract, pricing, and buy rate and sell rate data. For example, utilizing the contract screen 300, internal users 88 of the access records system as illustrated in **Figure 5**, may input contract specific details according to which transaction values for a service access transaction may be calculated in the manner described above. The contract screen 30 provides a convenient interface for the input of this information. Other screens that may be presented by the data management application 114 include a customer screen for receiving customer information, a technical configuration screen for receiving technical configuration information for a customer or a provider, a POP screen for maintaining access points, an account balance screen that provides access to customer account balances, end-user account balances, invoices, CDRs, billing events, payments and adjustments, a payment processing screen that allows payments to be applied by accounting personnel as they are received, an adjustment processing screen for facilitating CDR and invoice adjustments, etc.

Figure 18 illustrates an exemplary billing statement 302 that is generated by the settlement system 53, and that may be accessed on-line by a service provider 32, or customer 36, to view the current state of an account balance. As described above, the billing statement 302 may comprise near real-time, and summarized account balance information. Specifically, where the billing statement 302 is for a service provider 32, the billing statement 302 may present an account payable balance that is automatically updated in the manner described above. Similarly, where the billing statement 302 is for a customer 36, the statement 302 will present an account receivable balance that is updated in near real-time.

Figure 19 illustrates an exemplary client usage report 304 that may again be generated by the access broker system 34, for viewing by, for example, a customer 36. The customer usage report provides transaction identifier, user identifier, location, date and time information regarding all network transactions pertaining to a specific customer or provider within a predetermined time interval.

Similarly, **Figure 20** illustrates an exemplary service provider report 306 that may be automatically generated and presented to a service provider 32 by the access

broker system 34 to report all service access transactions that the relevant service provider that may have facilitated. Again, a transaction identifier, user identifier, location, data and time information are specified.

Figure 21 illustrates an exemplary call detail report 308, which provides a view of CDR records in comma-delimited format.

Computer System

Figure 22 shows a diagrammatic representation of machine in the exemplary form of a computer system 400 within which a set of instructions, for causing the machine to perform any one of the methodologies discussed above, may be executed. In alternative embodiments, the machine may comprise a network router, a network switch, a network bridge, Personal Digital Assistant (PDA), a cellular telephone, a web appliance or any machine capable of executing a sequence of instructions that specify actions to be taken by that machine.

The computer system 400 includes a processor 402, a main memory 404 and a static memory 406, which communicate with each other via a bus 408. The computer system 400 may further include a video display unit 310 (e.g., a liquid crystal display (LCD) or a cathode ray tube (CRT)). The computer system 400 also includes an alphanumeric input device 412 (e.g., a keyboard), a cursor control device 414 (e.g., a mouse), a disk drive unit 416, a signal generation device 418 (e.g., a speaker) and a network interface device 420.

The disk drive unit 416 includes a machine-readable medium 422 on which is stored a set of instructions (i.e., software) 424 embodying any one, or all, of the methodologies described above. The software 424 is also shown to reside, completely or at least partially, within the main memory 404 and/or within the processor 402. The software 424 may further be transmitted or received via the network interface device 420. For the purposes of this specification, the term "machine-readable medium" shall be taken to include any medium which is capable of storing or encoding a sequence of instructions for execution by the machine and that cause the machine to perform any one of the methodologies of the present invention. The term "machine-readable medium" shall accordingly be taken to included, but not be limited to, solid-state memories, optical and magnetic disks, and carrier wave

signals.

Thus, a method and system to normalize transaction data pertaining to accesses to a service provided via a plurality of service providers have been described. Although the present invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

CLAIMS

What is claimed is:

1. A method of processing transaction data pertaining to access to a service provided via a plurality of service providers, the transaction data being retrieved from a plurality of transaction data sources, the method including:

instantiating a dedicated load process at a transaction broker for each of the plurality of transaction data sources; and

retrieving transaction data from the plurality of transaction data sources, each dedicated load process operating to load transaction data from an associated transaction data source.

2. The method of claim 1 wherein each of the load processes is scheduled to retrieve the transaction data at a predetermined time interval.

3. The method of claim 2 wherein the predetermined time interval is between one minute and one hour.

4. The method of claim 1 wherein each of the load processes comprises a distinct thread.

5. The method of claim 2 including updating an accounts payable balance for a first service provider and updating an accounts receivable balance for a first service customer utilizing the retrieved data.

6. The method of claim 5 wherein the predetermined time interval is such to facilitate near real-time updating of the accounts payable and accounts receivable balances.

7. The method of claim 5 including performing a credit limit verification of the accounts receivable balance of the first service customer following the updating thereof utilizing the retrieved data.

8. The method of claim 2 wherein the predetermined time interval is configurable.

9. The method of claim 1 wherein the plurality of transaction data sources include at least one service provider.

10. The method of claim 1 wherein the plurality of data sources include at least one transaction server that facilitates access to a network via any one of a plurality of service providers.

11. A system to process transaction data pertaining to access to a service provided via a plurality of service providers, the system including:

a plurality of transaction data sources; and

a plurality of dedicated load processes at a transaction broker, each of the plurality of dedicated load processes to load transaction data from an associated transaction data source.

12. The system of claim 11 wherein each of the load processes is scheduled to retrieve the transaction data at a predetermined time interval.

13. The system of claim 12 wherein the predetermined time interval is between one minute and one hour.

14. The system of claim 11 wherein each of the load processes comprises a distinct thread.

15. The system of claim 12 including a settlement application to update an accounts payable balance for a first service provider and to update an accounts receivable balance for a first service customer utilizing the retrieved data.

16. The system of claim 15 wherein the predetermined time interval is such to facilitate near real-time updating of the accounts payable and accounts receivable balances.

17. The system of claim 15 wherein the settlement application is to perform a credit limit verification of the accounts receivable balance of the first service customer following the updating thereof utilizing the retrieved data.

18. The system of claim 12 wherein the predetermined time interval is configurable.

19. The system of claim 11 wherein the plurality of transaction data sources includes at least one service provider.

20. The system of claim 11 wherein the plurality of transaction data sources includes at least one transaction server that facilitates access to a network via any one of a plurality of service providers.

21. A machine-readable medium embodying a sequence of instructions that, when executed by a machine, cause the machine to:

instantiate a dedicated load process at a transaction broker for each of a plurality of transaction data sources; and

retrieve transaction data from the plurality of transaction data sources, each dedicated load process operating to load transaction data from an associated transaction data source.

22. A system to process transaction data pertaining to access to a service provided via a plurality of service providers, the system including:

a plurality of transaction data sources; and

a plurality of load means, each of the plurality load means for loading transaction data from an associated transaction data source.

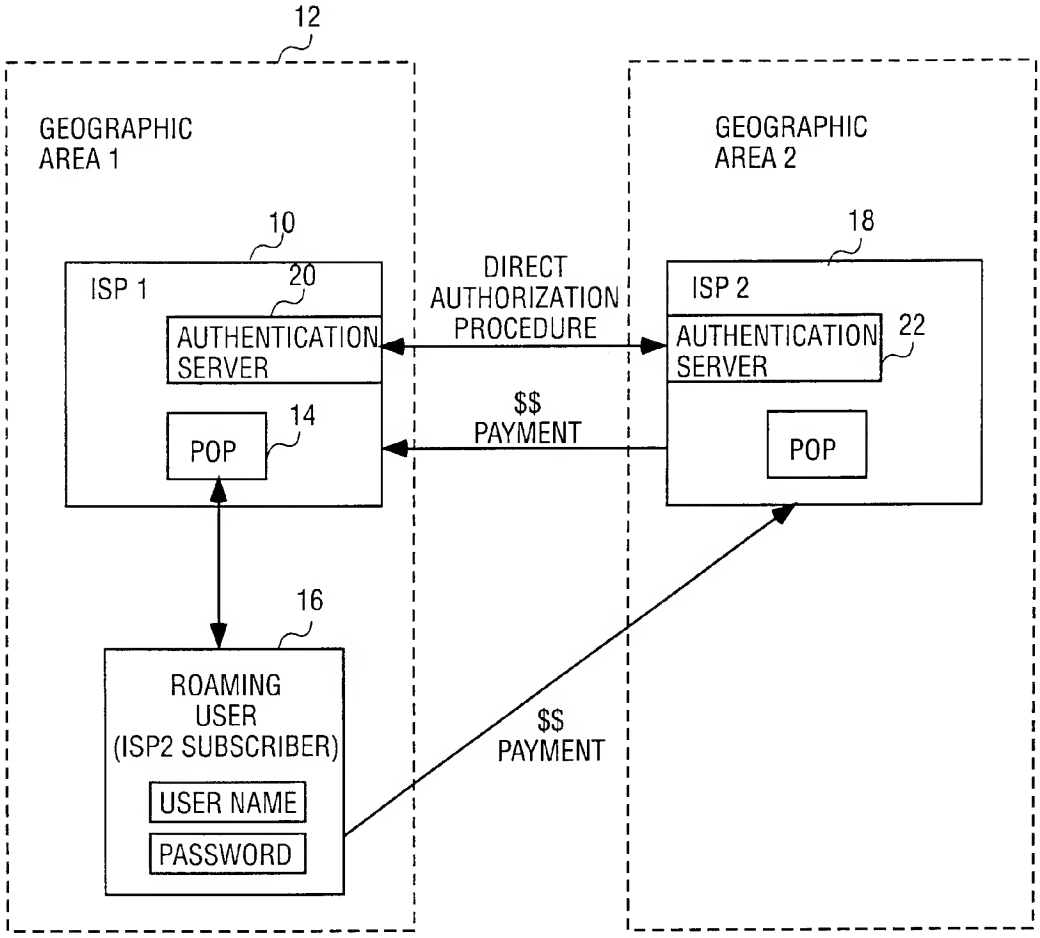

FIG. 1
(PRIOR ART)

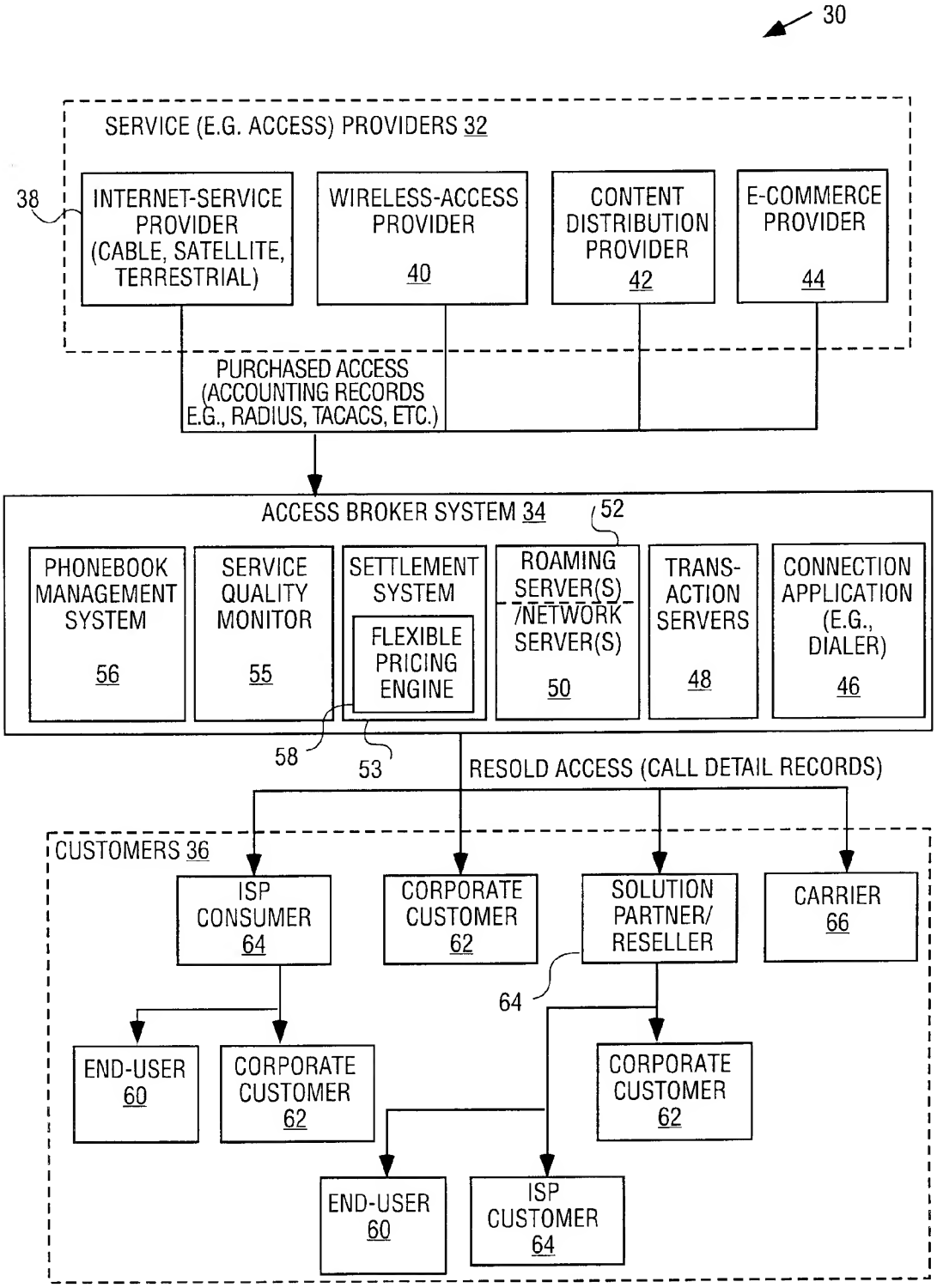
30
SERVICE (E.G. ACCESS) PROVIDERS 32
38
INTERNET-SERVICE PROVIDER (CABLE, SATELLITE, TERRESTRIAL)
WIRELESS-ACCESS PROVIDER 40
CONTENT DISTRIBUTION PROVIDER 42
E-COMMERCE PROVIDER 44
PURCHASED ACCESS (ACCOUNTING RECORDS E.G., RADIUS, TACACS, ETC.)
ACCESS BROKER SYSTEM 34
52
PHONEBOOK MANAGEMENT SYSTEM 56
SERVICE QUALITY MONITOR 55
SETTLEMENT SYSTEM
FLEXIBLE PRICING ENGINE
ROAMING SERVER(S) /NETWORK SERVER(S) 50
TRANS-ACTION SERVERS 48
CONNECTION APPLICATION (E.G., DIALER) 46
58
53
RESOLD ACCESS (CALL DETAIL RECORDS)
CUSTOMERS 36
ISP CONSUMER 64
CORPORATE CUSTOMER 62
SOLUTION PARTNER/ RESELLER
CARRIER 66
64
END-USER 60
CORPORATE CUSTOMER 62
CORPORATE CUSTOMER 62
END-USER 60
ISP CUSTOMER 64

FIG. 2

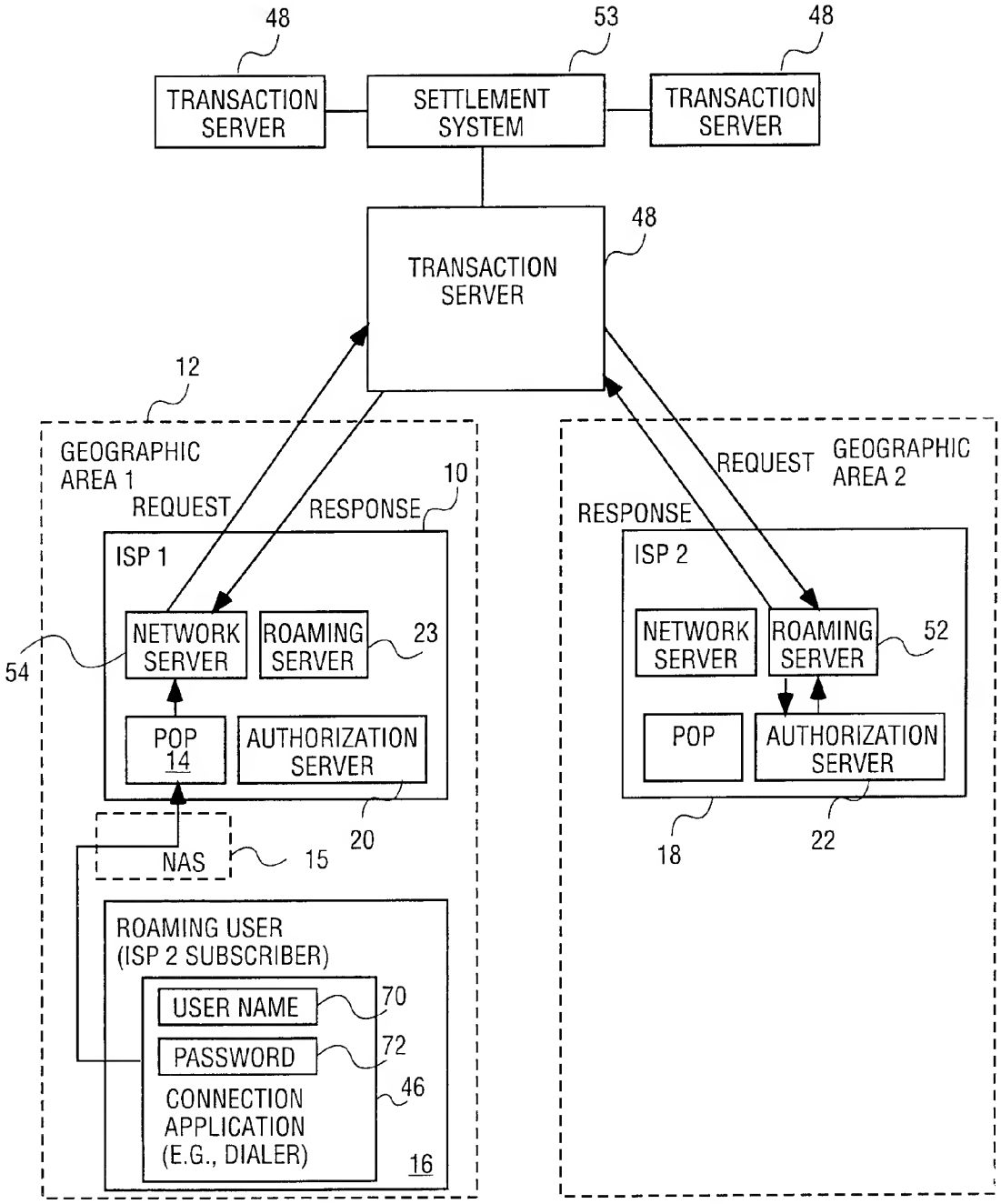
48
53
48
TRANSACTION SERVER
SETTLEMENT SYSTEM
TRANSACTION SERVER
48
TRANSACTION SERVER
12
GEOGRAPHIC AREA 1
REQUEST
RESPONSE
10
ISP 1
NETWORK SERVER
ROAMING SERVER
23
54
POP 14
AUTHORIZATION SERVER
20
NAS
15
ROAMING USER (ISP 2 SUBSCRIBER)
USER NAME
70
PASSWORD
72
CONNECTION APPLICATION (E.G., DIALER)
46
16
REQUEST
GEOGRAPHIC AREA 2
RESPONSE
ISP 2
NETWORK SERVER
ROAMING SERVER
52
POP
AUTHORIZATION SERVER
18
22

FIG. 3

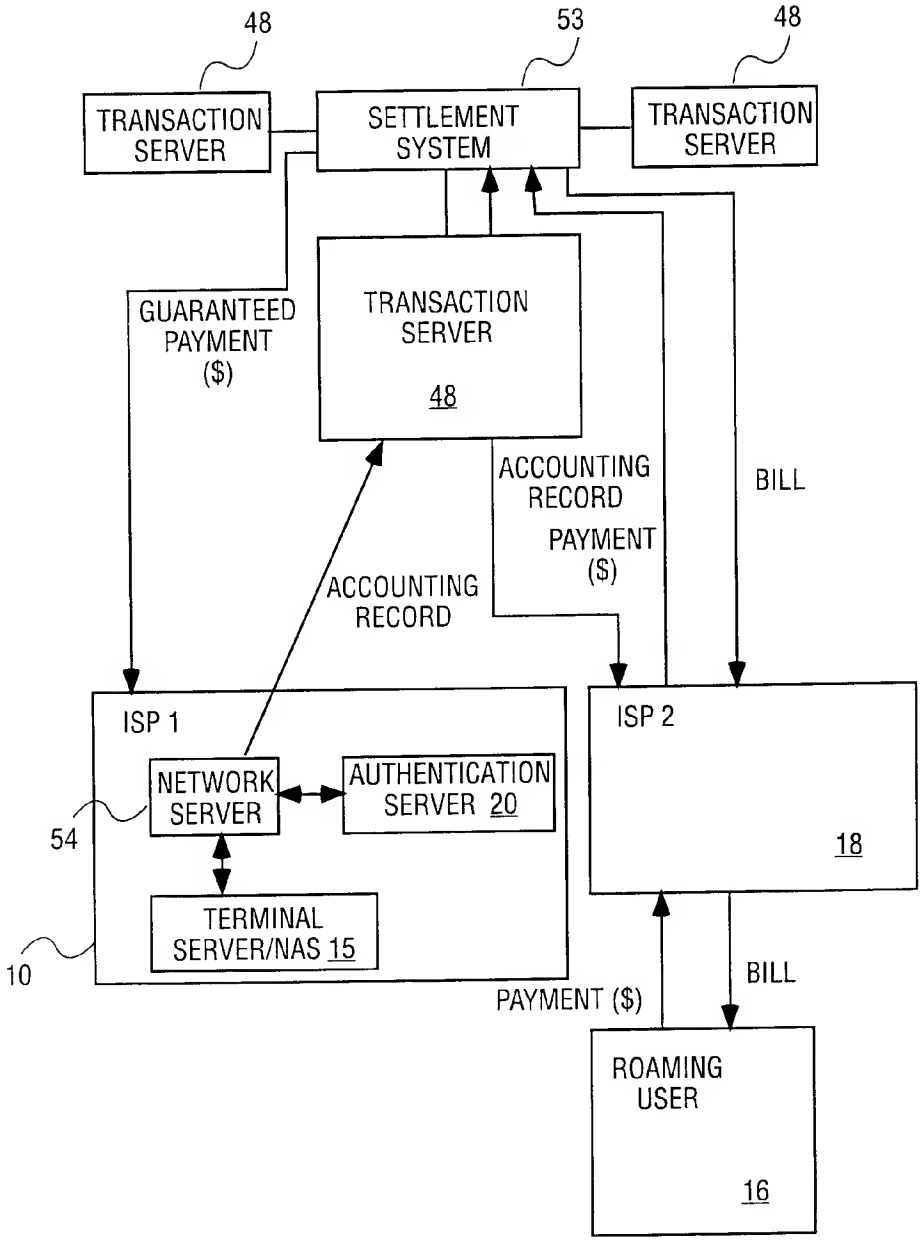
48
53
48
TRANSACTION SERVER
SETTLEMENT SYSTEM
TRANSACTION SERVER
GUARANTEED PAYMENT ($)
TRANSACTION SERVER 48
ACCOUNTING RECORD
PAYMENT ($)
BILL
ACCOUNTING RECORD
ISP 1
ISP 2
NETWORK SERVER
AUTHENTICATION SERVER 20
54
18
TERMINAL SERVER/NAS 15
10
BILL
PAYMENT ($)
ROAMING USER
16

FIG. 4

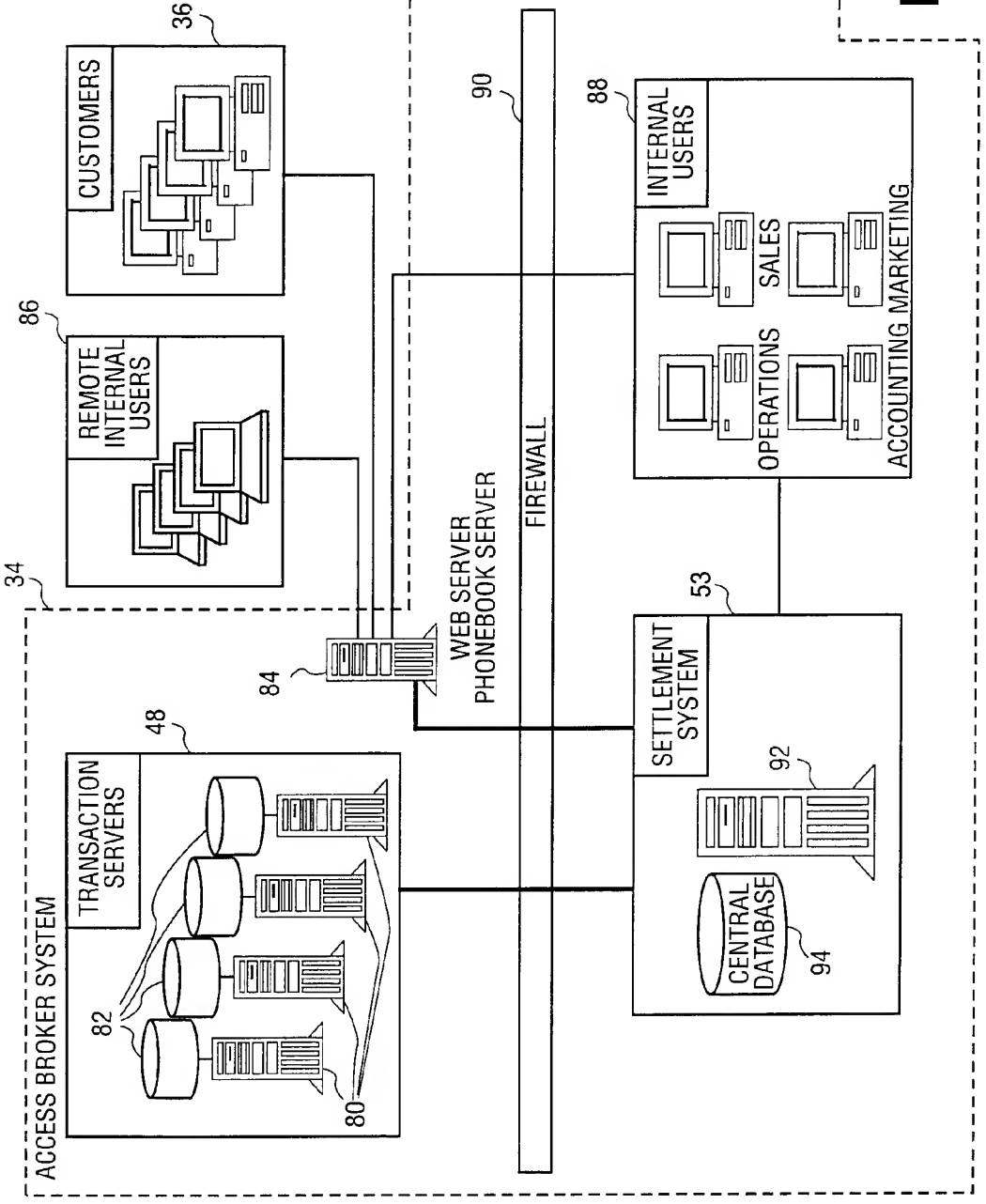
ACCESS BROKER SYSTEM
34
TRANSACTION SERVERS
48
82
80
WEB SERVER PHONEBOOK SERVER
84
FIREWALL
90
SETTLEMENT SYSTEM
53
92
CENTRAL DATABASE
94
INTERNAL USERS
88
SALES
OPERATIONS
ACCOUNTING MARKETING
REMOTE INTERNAL USERS
86
CUSTOMERS
36

FIG. 5

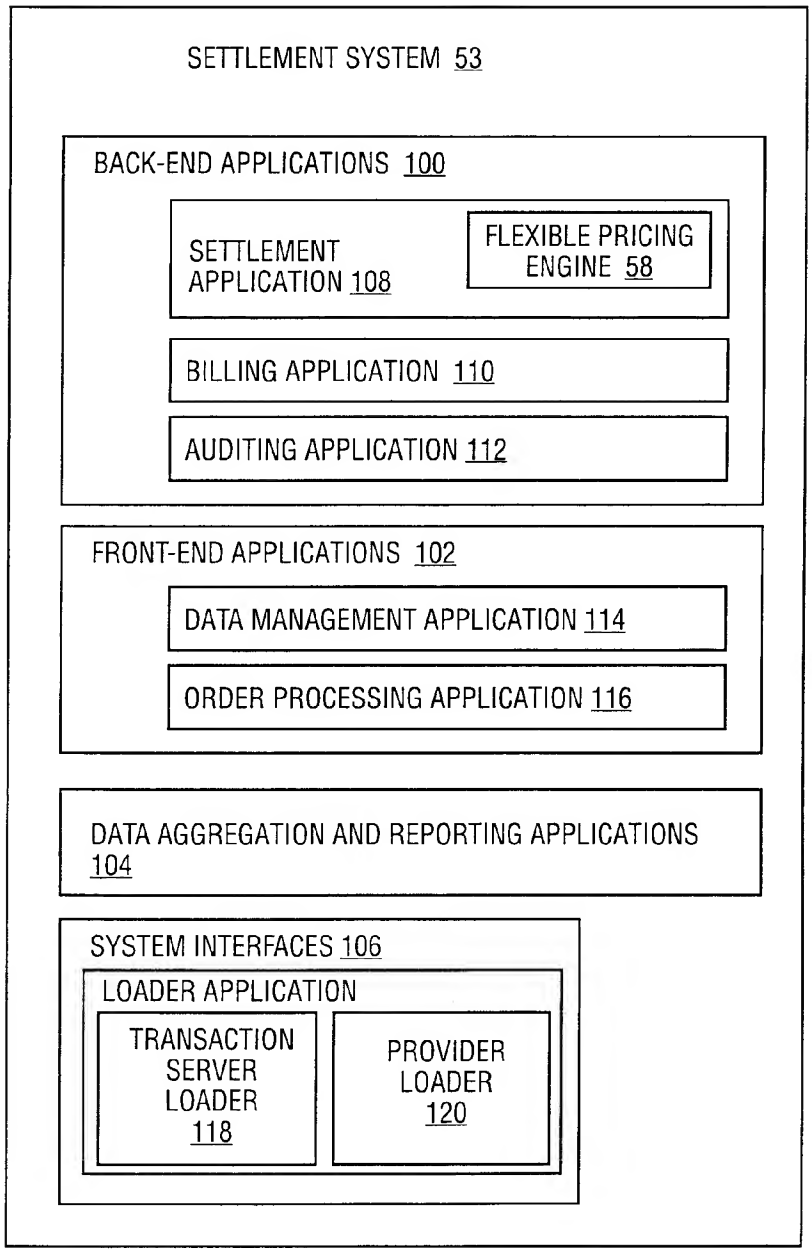
SETTLEMENT SYSTEM 53
BACK-END APPLICATIONS 100
SETTLEMENT APPLICATION 108
FLEXIBLE PRICING ENGINE 58
BILLING APPLICATION 110
AUDITING APPLICATION 112
FRONT-END APPLICATIONS 102
DATA MANAGEMENT APPLICATION 114
ORDER PROCESSING APPLICATION 116
DATA AGGREGATION AND REPORTING APPLICATIONS 104
SYSTEM INTERFACES 106
LOADER APPLICATION
TRANSACTION SERVER LOADER 118
PROVIDER LOADER 120

FIG. 6A

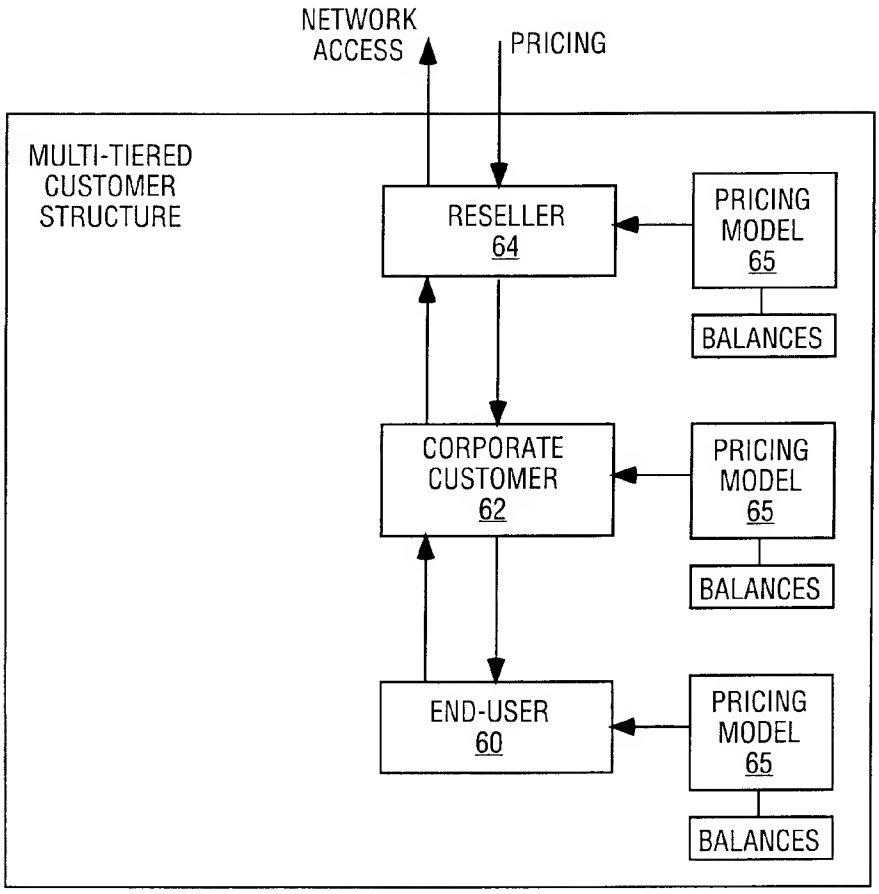
NETWORK ACCESS
PRICING
MULTI-TIERED CUSTOMER STRUCTURE
RESELLER 64
PRICING MODEL 65
BALANCES
CORPORATE CUSTOMER 62
PRICING MODEL 65
BALANCES
END-USER 60
PRICING MODEL 65
BALANCES

FIG. 6B

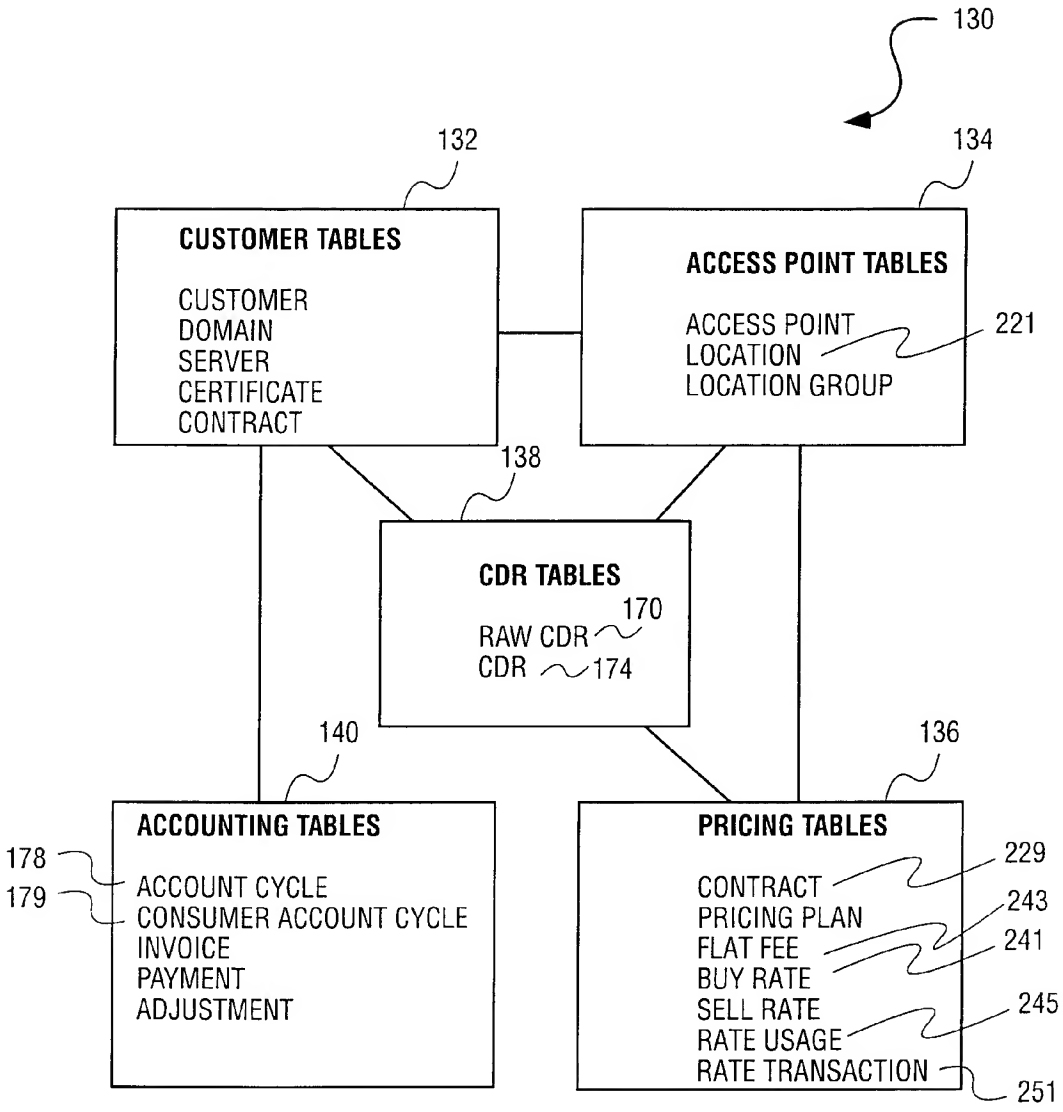
130
132
134
CUSTOMER TABLES
CUSTOMER
DOMAIN
SERVER
CERTIFICATE
CONTRACT
ACCESS POINT TABLES
ACCESS POINT
LOCATION
LOCATION GROUP
221
138
CDR TABLES
170
RAW CDR
CDR
174
140
136
ACCOUNTING TABLES
178
179
ACCOUNT CYCLE
CONSUMER ACCOUNT CYCLE
INVOICE
PAYMENT
ADJUSTMENT
PRICING TABLES
229
CONTRACT
PRICING PLAN
243
FLAT FEE
241
BUY RATE
SELL RATE
245
RATE USAGE
RATE TRANSACTION
251

FIG. 7

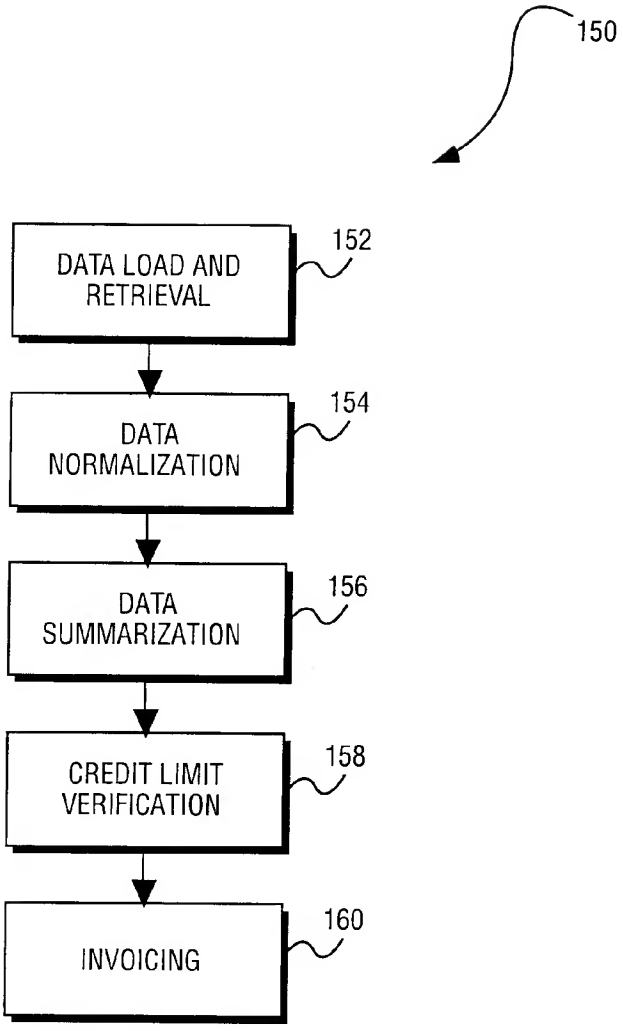
150
DATA LOAD AND RETRIEVAL
152
DATA NORMALIZATION
154
DATA SUMMARIZATION
156
CREDIT LIMIT VERIFICATION
158
INVOICING
160

FIG. 8

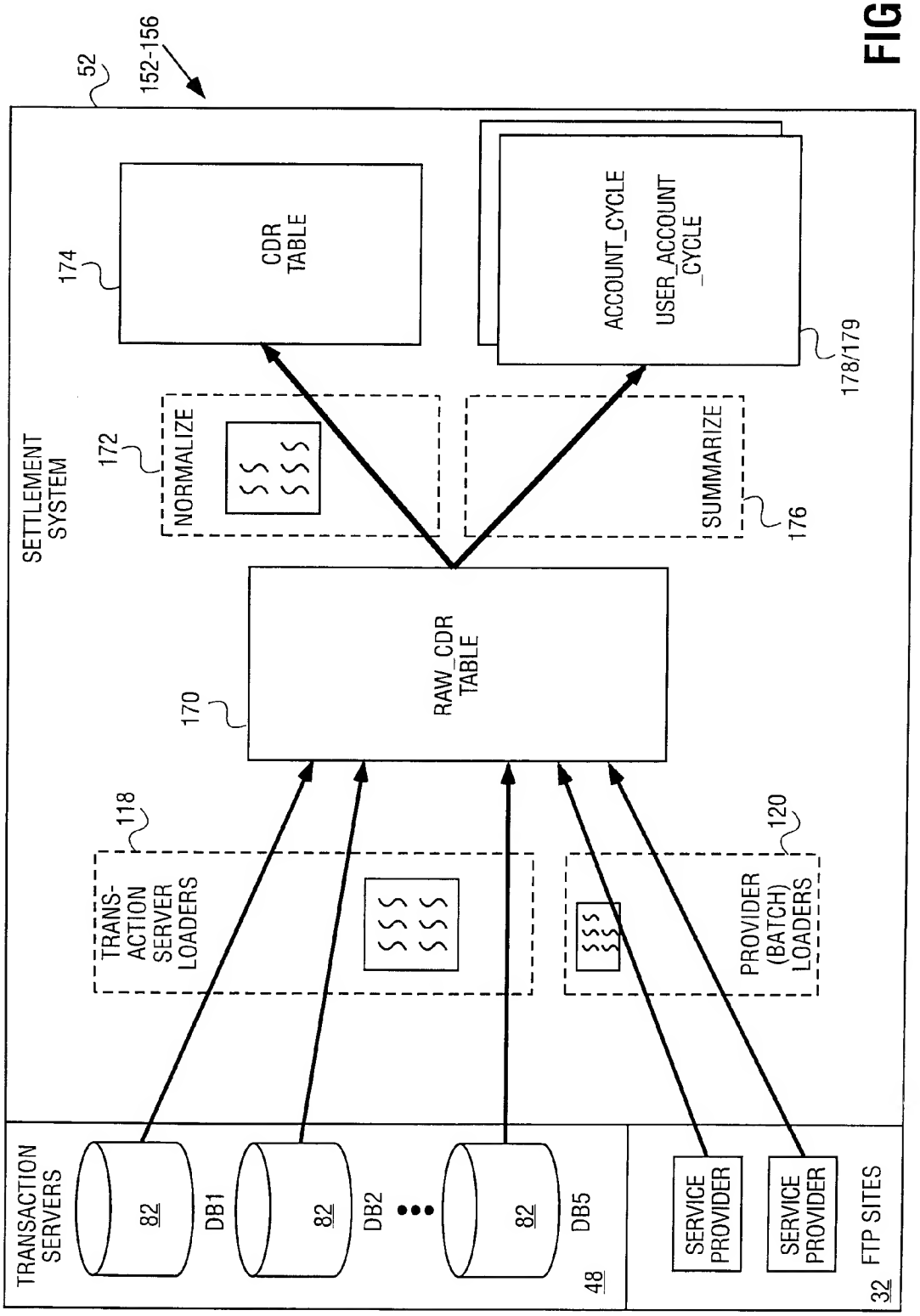
52
152-156
SETTLEMENT SYSTEM
174
CDR TABLE
ACCOUNT_CYCLE
USER_ACCOUNT _CYCLE
178/179
172
NORMALIZE
SUMMARIZE
176
170
RAW_CDR TABLE
118
TRANS-ACTION SERVER LOADERS
120
PROVIDER (BATCH) LOADERS
TRANSACTION SERVERS
82
DB1
DB2
DB5
48
SERVICE PROVIDER
SERVICE PROVIDER
FTP SITES
32

FIG. 9

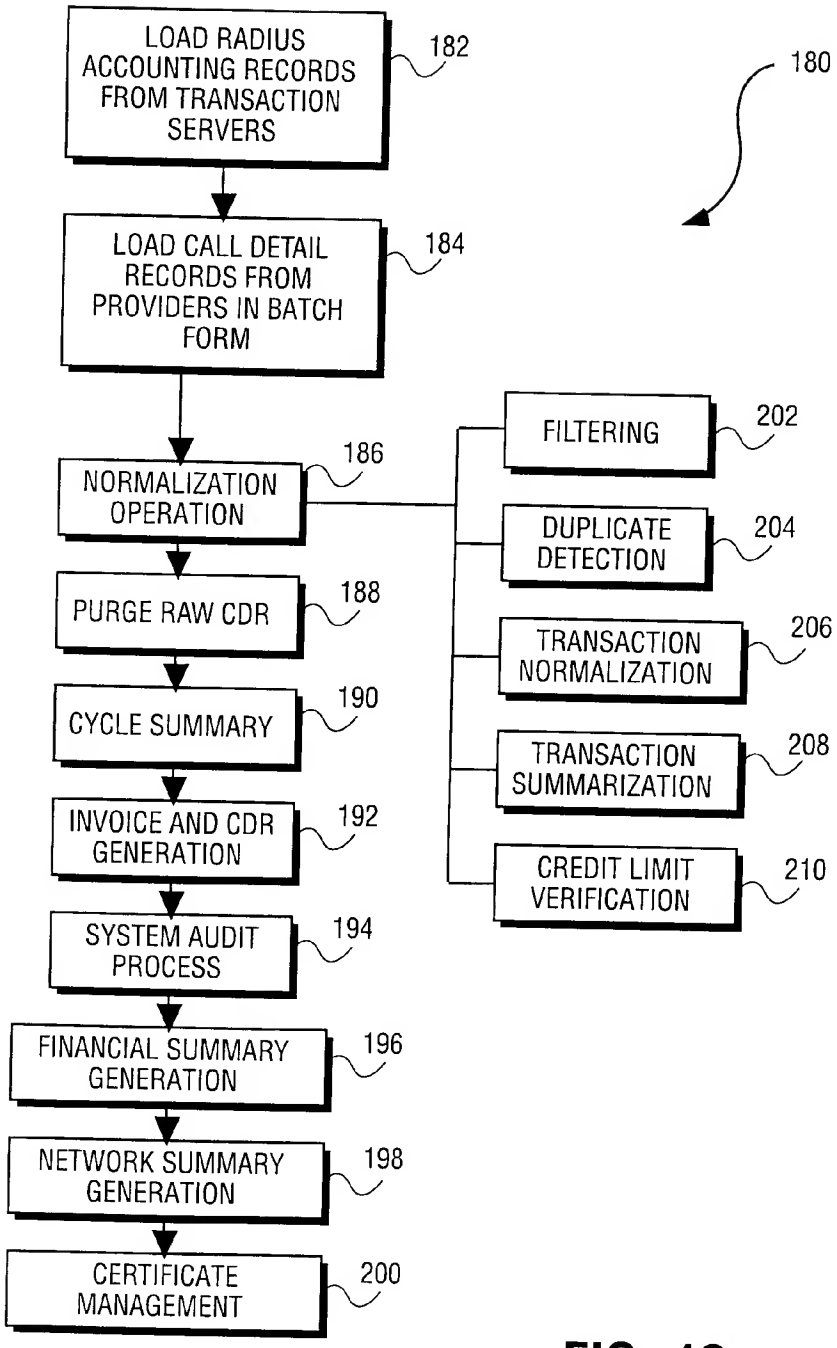
LOAD RADIUS ACCOUNTING RECORDS FROM TRANSACTION SERVERS
182
180
LOAD CALL DETAIL RECORDS FROM PROVIDERS IN BATCH FORM
184
NORMALIZATION OPERATION
186
FILTERING
202
DUPLICATE DETECTION
204
TRANSACTION NORMALIZATION
206
TRANSACTION SUMMARIZATION
208
CREDIT LIMIT VERIFICATION
210
PURGE RAW CDR
188
CYCLE SUMMARY
190
INVOICE AND CDR GENERATION
192
SYSTEM AUDIT PROCESS
194
FINANCIAL SUMMARY GENERATION
196
NETWORK SUMMARY GENERATION
198
CERTIFICATE MANAGEMENT
200

FIG. 10

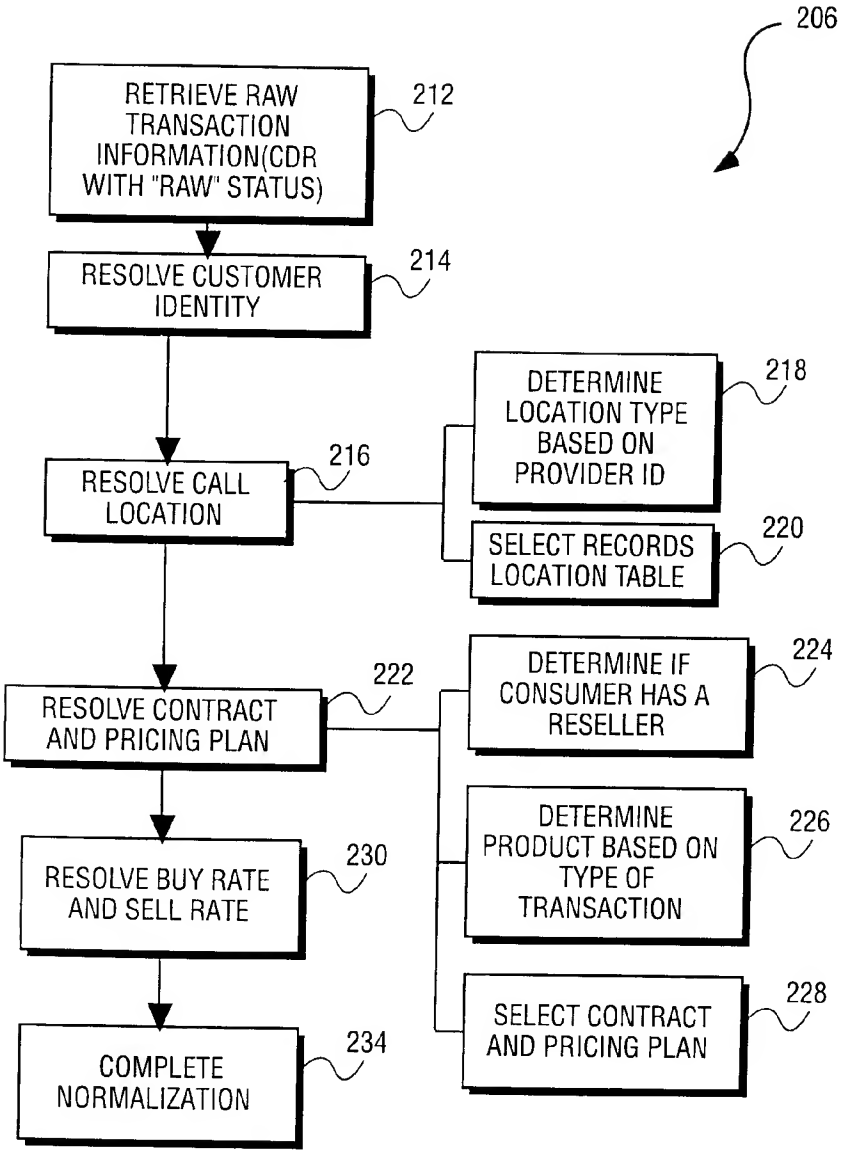
206
RETRIEVE RAW TRANSACTION INFORMATION(CDR WITH "RAW" STATUS)
212
RESOLVE CUSTOMER IDENTITY
214
RESOLVE CALL LOCATION
216
DETERMINE LOCATION TYPE BASED ON PROVIDER ID
218
SELECT RECORDS LOCATION TABLE
220
RESOLVE CONTRACT AND PRICING PLAN
222
DETERMINE IF CONSUMER HAS A RESELLER
224
DETERMINE PRODUCT BASED ON TYPE OF TRANSACTION
226
SELECT CONTRACT AND PRICING PLAN
228
RESOLVE BUY RATE AND SELL RATE
230
COMPLETE NORMALIZATION
234

FIG. 11

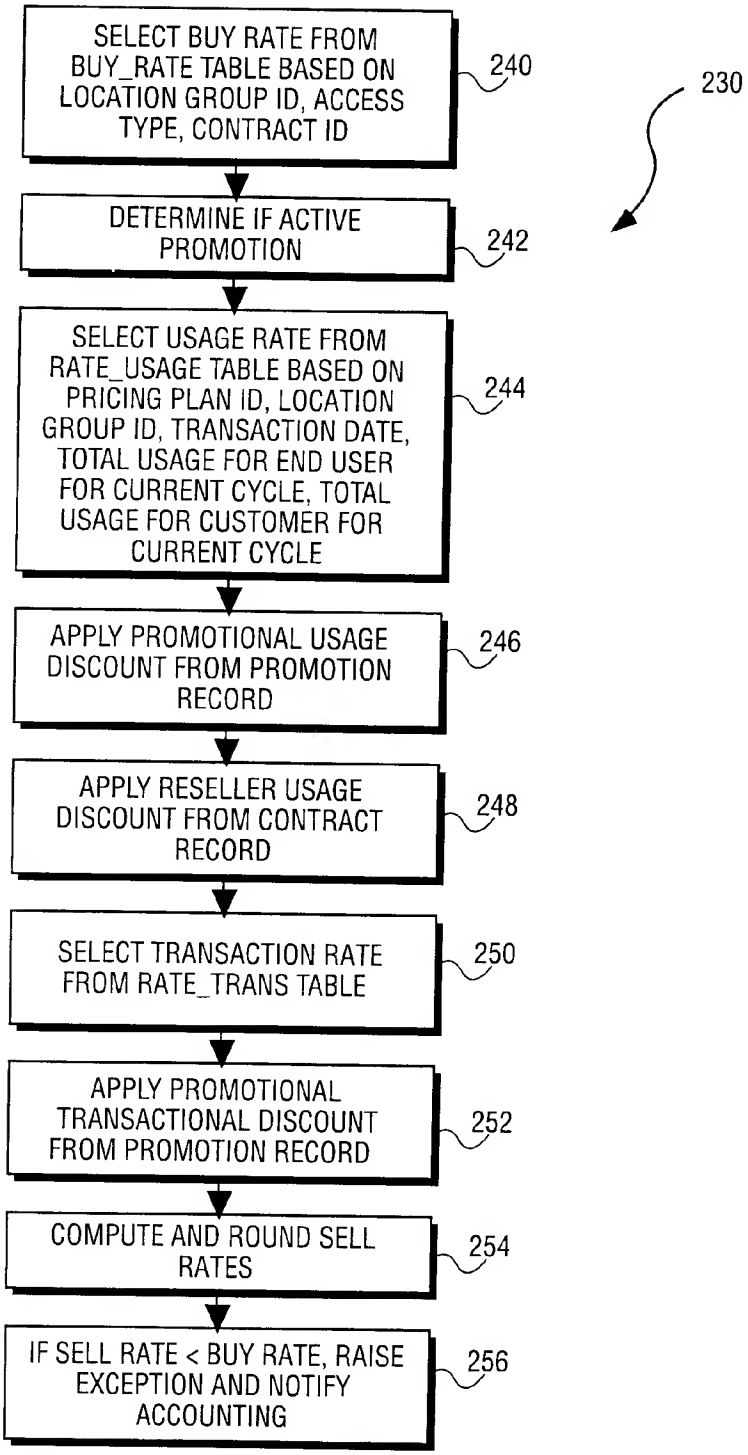
SELECT BUY RATE FROM BUY_RATE TABLE BASED ON LOCATION GROUP ID, ACCESS TYPE, CONTRACT ID
240
230
DETERMINE IF ACTIVE PROMOTION
242
SELECT USAGE RATE FROM RATE_USAGE TABLE BASED ON PRICING PLAN ID, LOCATION GROUP ID, TRANSACTION DATE, TOTAL USAGE FOR END USER FOR CURRENT CYCLE, TOTAL USAGE FOR CUSTOMER FOR CURRENT CYCLE
244
APPLY PROMOTIONAL USAGE DISCOUNT FROM PROMOTION RECORD
246
APPLY RESELLER USAGE DISCOUNT FROM CONTRACT RECORD
248
SELECT TRANSACTION RATE FROM RATE_TRANS TABLE
250
APPLY PROMOTIONAL TRANSACTIONAL DISCOUNT FROM PROMOTION RECORD
252
COMPUTE AND ROUND SELL RATES
254
IF SELL RATE < BUY RATE, RAISE EXCEPTION AND NOTIFY ACCOUNTING
256

FIG. 12

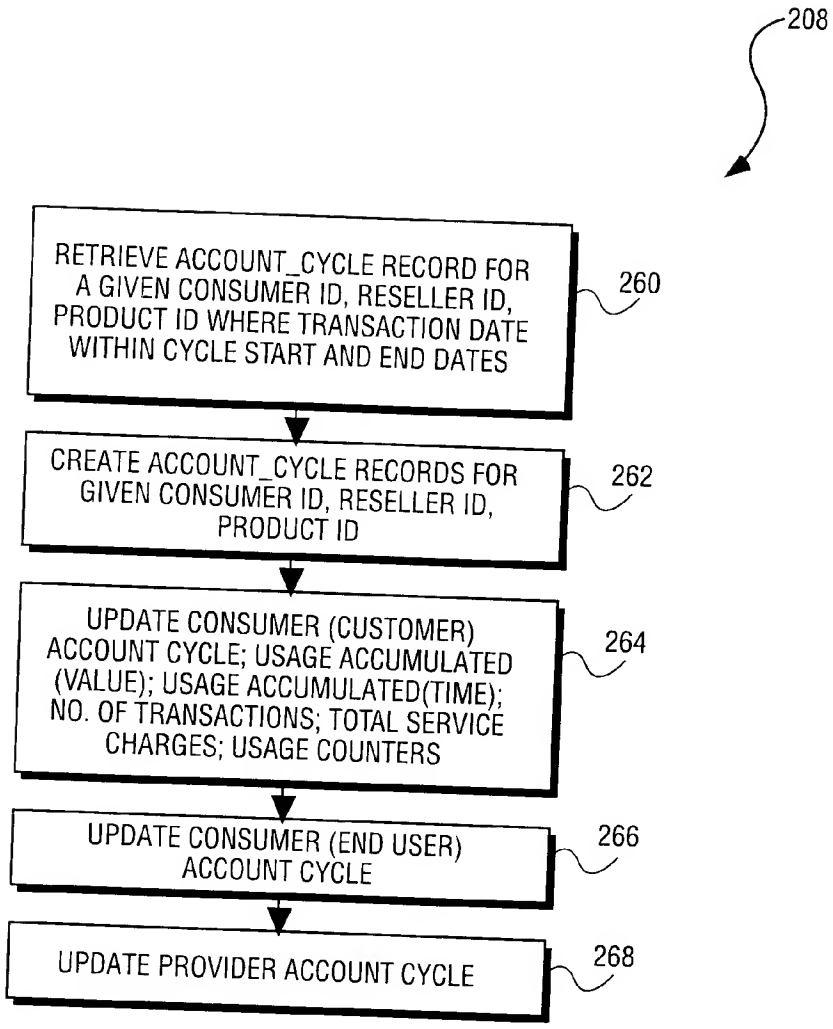
208
RETRIEVE ACCOUNT_CYCLE RECORD FOR A GIVEN CONSUMER ID, RESELLER ID, PRODUCT ID WHERE TRANSACTION DATE WITHIN CYCLE START AND END DATES
260
CREATE ACCOUNT_CYCLE RECORDS FOR GIVEN CONSUMER ID, RESELLER ID, PRODUCT ID
262
UPDATE CONSUMER (CUSTOMER) ACCOUNT CYCLE; USAGE ACCUMULATED (VALUE); USAGE ACCUMULATED(TIME); NO. OF TRANSACTIONS; TOTAL SERVICE CHARGES; USAGE COUNTERS
264
UPDATE CONSUMER (END USER) ACCOUNT CYCLE
266
UPDATE PROVIDER ACCOUNT CYCLE
268

FIG. 13A

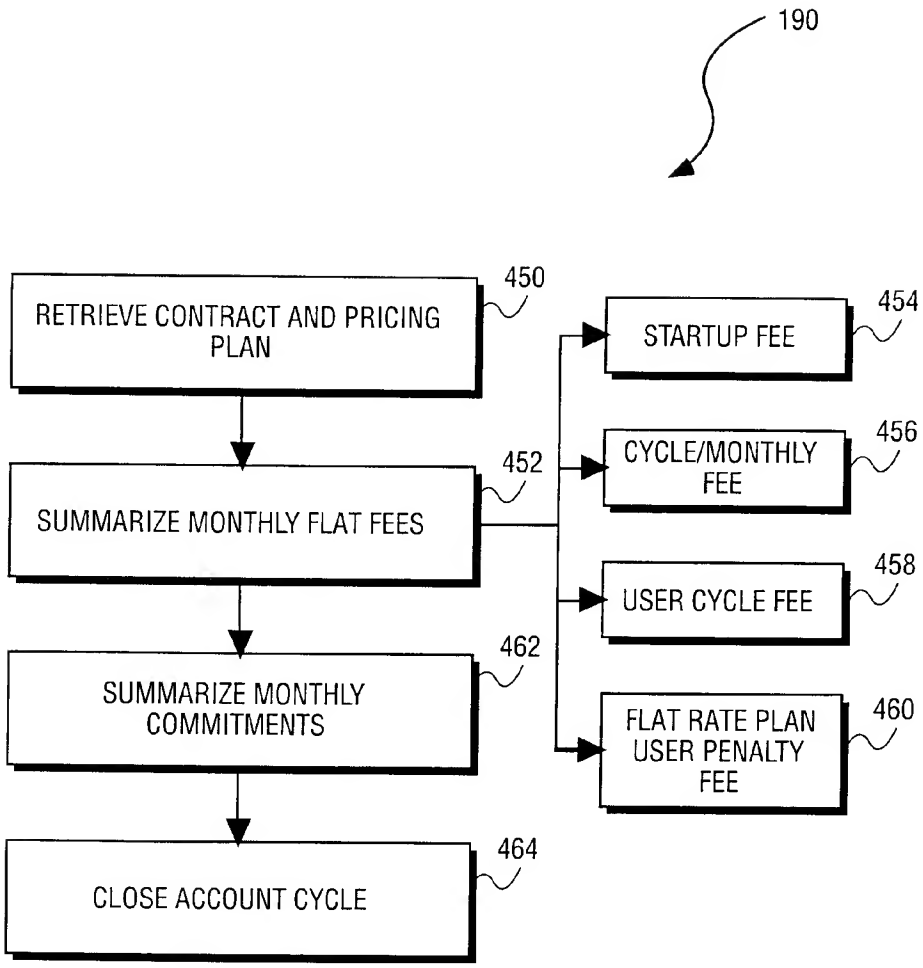
190
RETRIEVE CONTRACT AND PRICING PLAN
450
SUMMARIZE MONTHLY FLAT FEES
452
SUMMARIZE MONTHLY COMMITMENTS
462
CLOSE ACCOUNT CYCLE
464
STARTUP FEE
454
CYCLE/MONTHLY FEE
456
USER CYCLE FEE
458
FLAT RATE PLAN USER PENALTY FEE
460

FIG. 13B

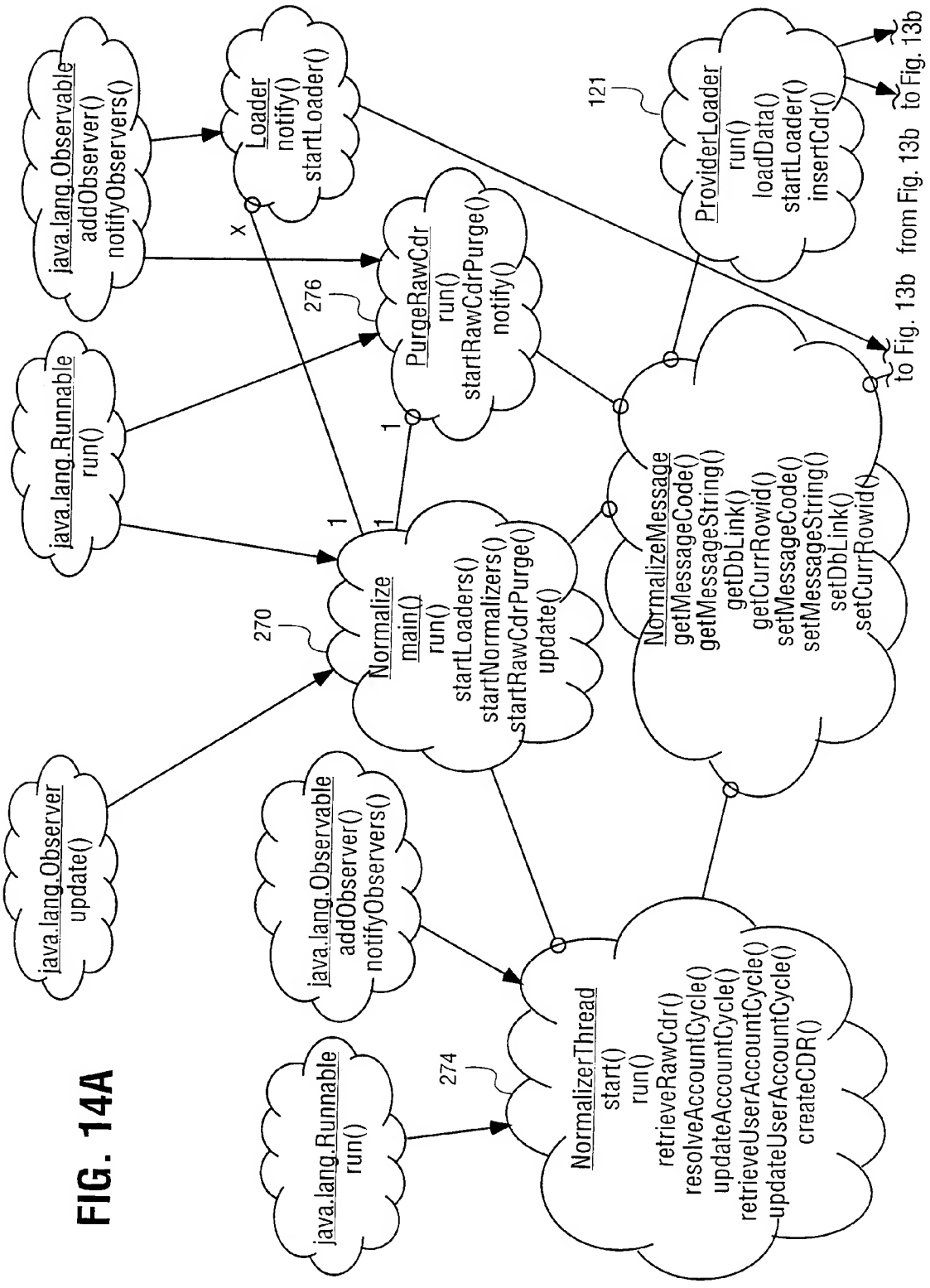
java.lang.Observer
update()
java.lang.Runnable
run()
java.lang.Observable
addObserver()
notifyObservers()
java.lang.Observable
addObserver()
notifyObservers()
Loader
notify()
startLoader()
PurgeRawCdr
run()
startRawCdrPurge()
notify()
Normalize
main()
run()
startLoaders()
startNormalizers()
startRawCdrPurge()
update()
NormalizeMessage
getMessageCode()
getMessageString()
getDbLink()
getCurrRowid()
setMessageCode()
setMessageString()
setDbLink()
setCurrRowid()
ProviderLoader
run()
loadData()
startLoader()
insertCdr()
NormalizerThread
start()
run()
retrieveRawCdr()
resolveAccountCycle()
updateAccountCycle()
retrieveUserAccountCycle()
updateUserAccountCycle()
createCDR()
java.lang.Runnable
run()
270
274
276
121
1
1
1
1
X
to Fig. 13b from Fig. 13b to Fig. 13b

FIG. 14A

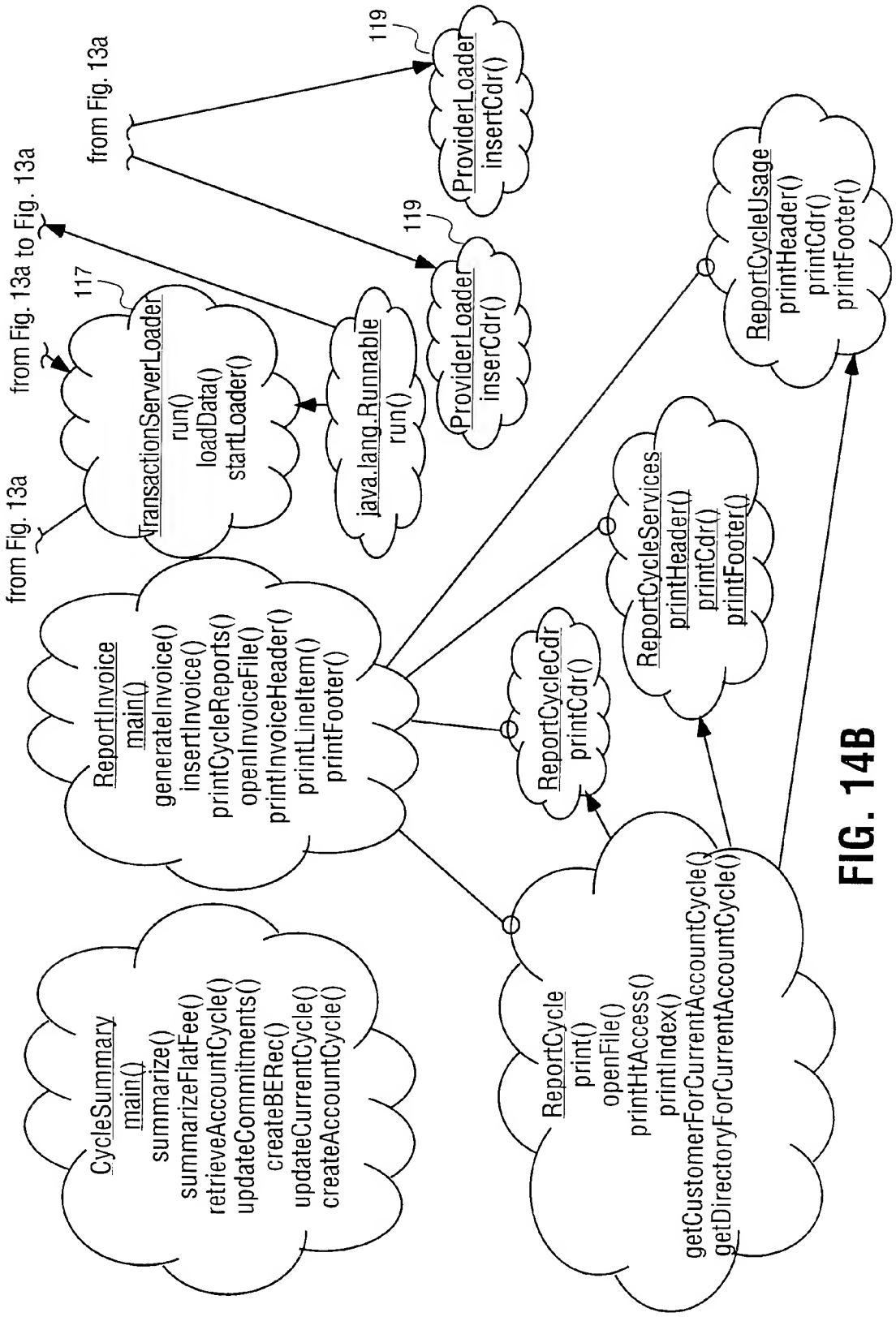
from Fig. 13a
from Fig. 13a to Fig. 13a
from Fig. 13a
117
119
119
TransactionServerLoader
run()
loadData()
startLoader()
java.lang.Runnable
run()
ProviderLoader
insertCdr()
ProviderLoader
insertCdr()
ReportInvoice
main()
generateInvoice()
insertInvoice()
printCycleReports()
openInvoiceFile()
printInvoiceHeader()
printLineItem()
printFooter()
ReportCycleCdr
printCdr()
ReportCycleServices
printHeader()
printCdr()
printFooter()
ReportCycleUsage
printHeader()
printCdr()
printFooter()
CycleSummary
main()
summarize()
summarizeFlatFee()
retrieveAccountCycle()
updateCommitments()
createBERec()
updateCurrentCycle()
createAccountCycle()
ReportCycle
print()
openFile()
printHtAccess()
printIndex()
getCustomerForCurrentAccountCycle()
getDirectoryForCurrentAccountCycle()

FIG. 14B

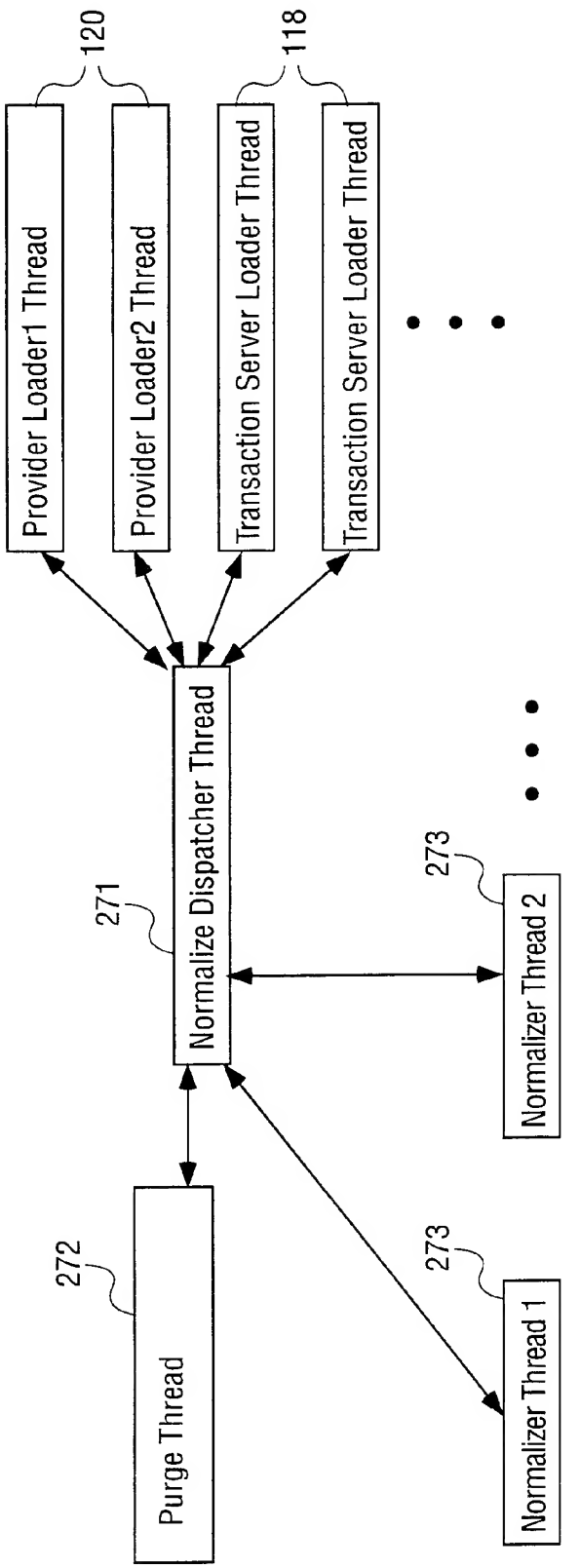
120
118
Provider Loader1 Thread
Provider Loader2 Thread
Transaction Server Loader Thread
Transaction Server Loader Thread
271
Normalize Dispatcher Thread
273
Normalizer Thread 2
272
Purge Thread
273
Normalizer Thread 1

FIG. 15

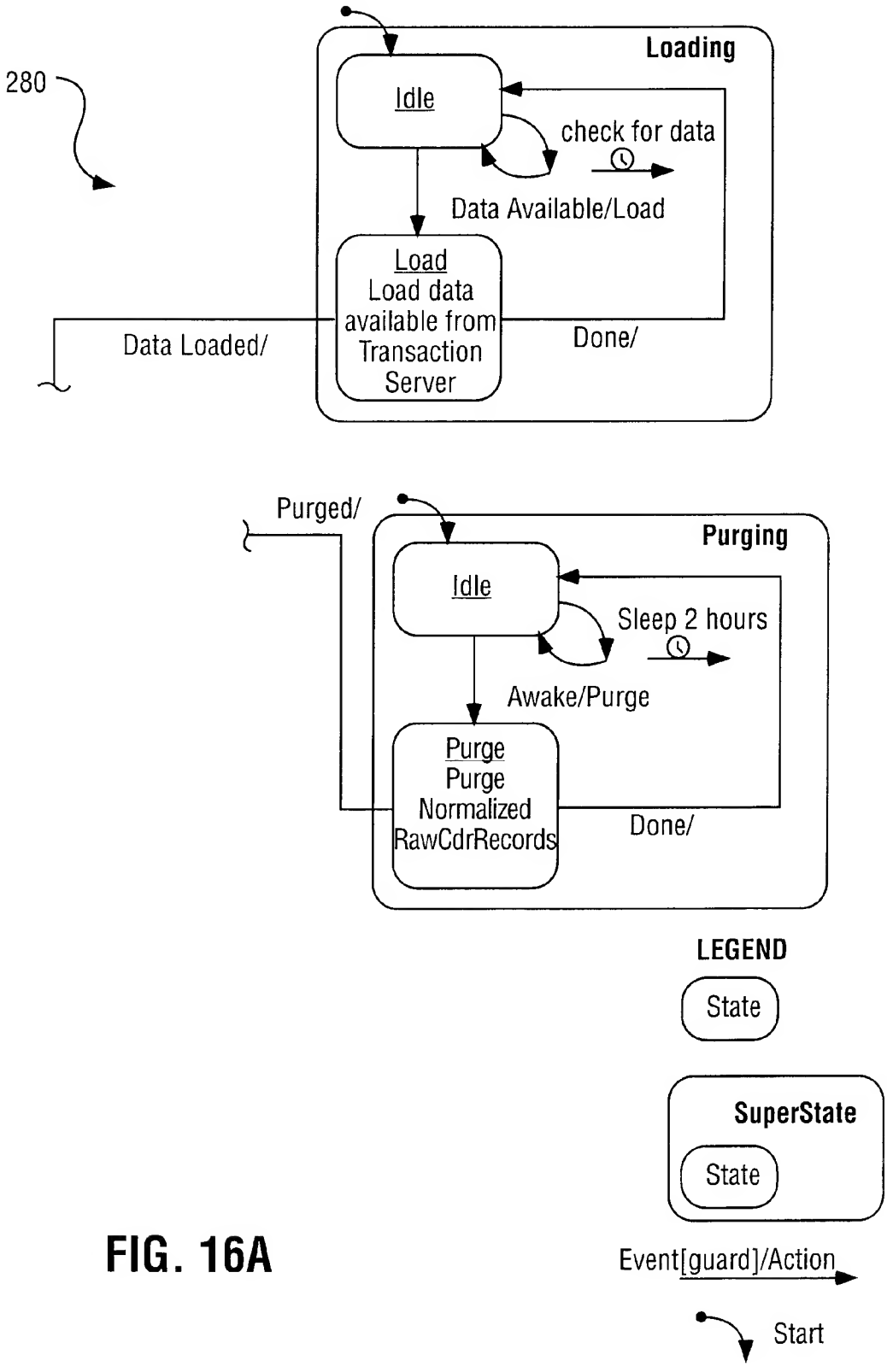
280
Loading
Idle
check for data
Data Available/Load
Load
Load data available from Transaction Server
Data Loaded/
Done/
Purged/
Purging
Idle
Sleep 2 hours
Awake/Purge
Purge
Purge Normalized RawCdrRecords
Done/
LEGEND
State
SuperState
State
Event[guard]/Action
Start

FIG. 16A

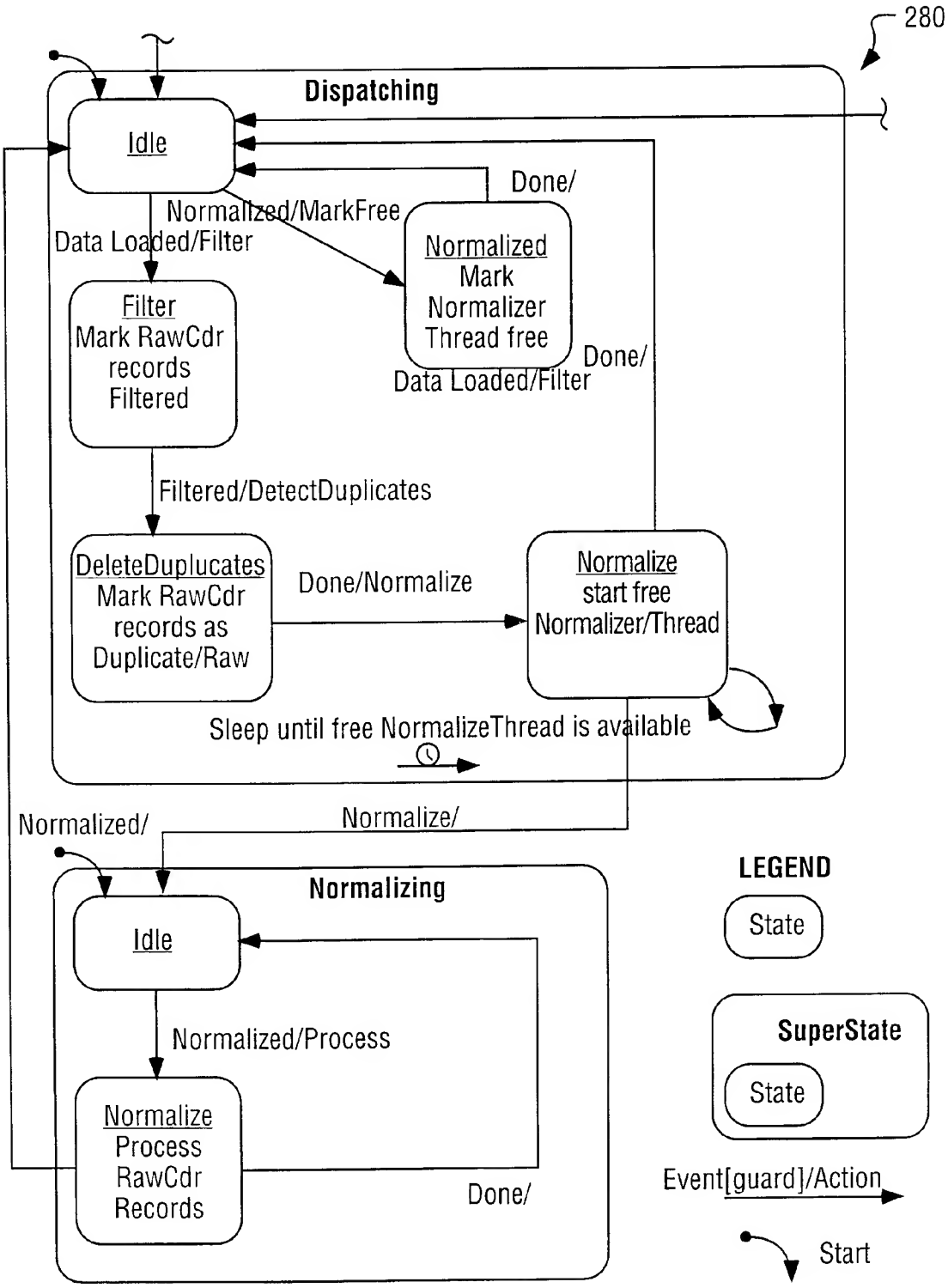
280
Dispatching
Idle
Done/
Normalized/MarkFree
Data Loaded/Filter
Normalized
Mark
Normalizer
Thread free
Done/
Data Loaded/Filter
Filter
Mark RawCdr
records
Filtered
Filtered/DetectDuplicates
DeleteDuplucates
Mark RawCdr
records as
Duplicate/Raw
Done/Normalize
Normalize
start free
Normalizer/Thread
Sleep until free NormalizeThread is available
Normalized/
Normalize/
Normalizing
Idle
Normalized/Process
Normalize
Process
RawCdr
Records
Done/
LEGEND
State
SuperState
State
Event[guard]/Action
Start

FIG. 16B

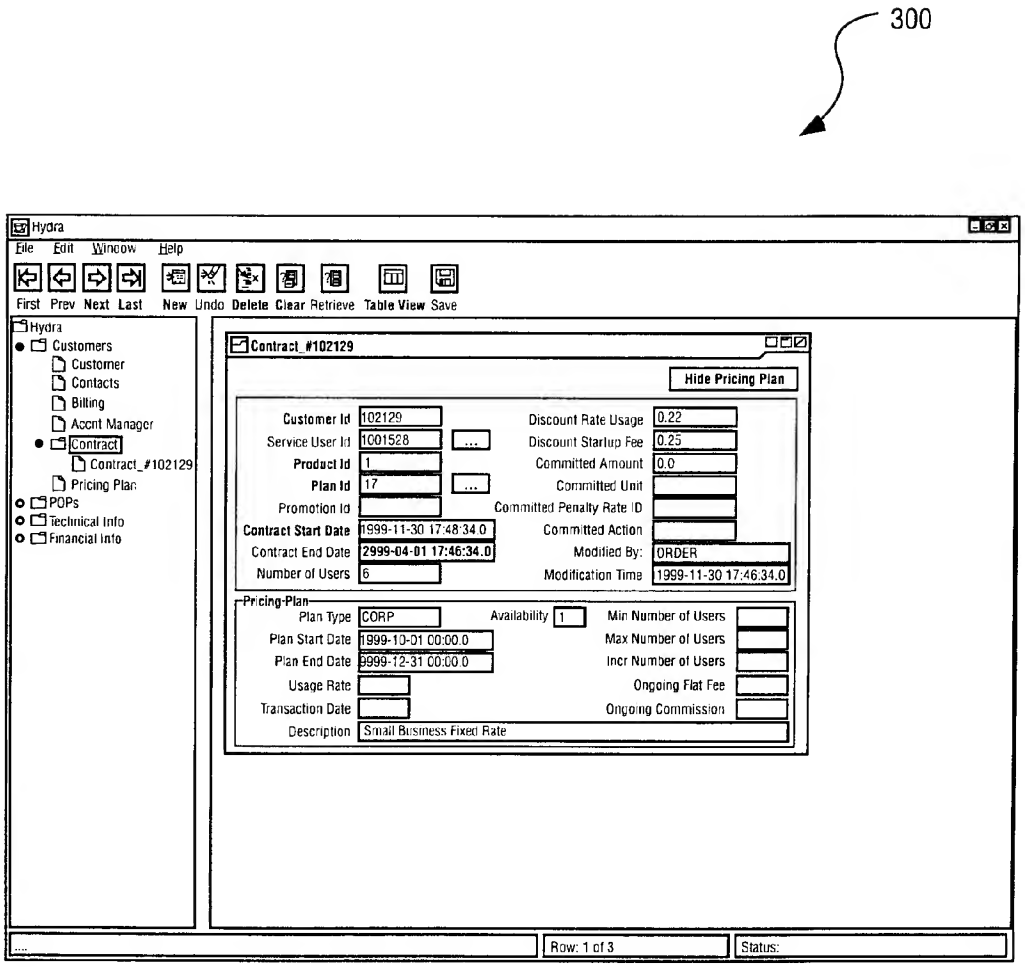
300
Hydra
File Edit Window Help
First Prev Next Last New Undo Delete Clear Retrieve Table View Save
Hydra
Customers
Customer
Contacts
Billing
Accnt Manager
Contract
Contract_#102129
Pricing Plan
POPs
Technical Info
Financial Info
Contract_#102129
Hide Pricing Plan
Customer Id 102129
Service User Id 1001528
Product Id 1
Plan Id 17
Promotion Id
Contract Start Date 1999-11-30 17:48:34.0
Contract End Date 2999-04-01 17:46:34.0
Number of Users 6
Discount Rate Usage 0.22
Discount Startup Fee 0.25
Committed Amount 0.0
Committed Unit
Committed Penalty Rate ID
Committed Action
Modified By: ORDER
Modification Time 1999-11-30 17:46:34.0
Pricing Plan
Plan Type CORP
Availability 1
Plan Start Date 1999-10-01 00:00.0
Plan End Date 9999-12-31 00:00.0
Usage Rate
Transaction Date
Description Small Business Fixed Rate
Min Number of Users
Max Number of Users
Incr Number of Users
Ongoing Flat Fee
Ongoing Commission
Row: 1 of 3
Status:

FIG. 17

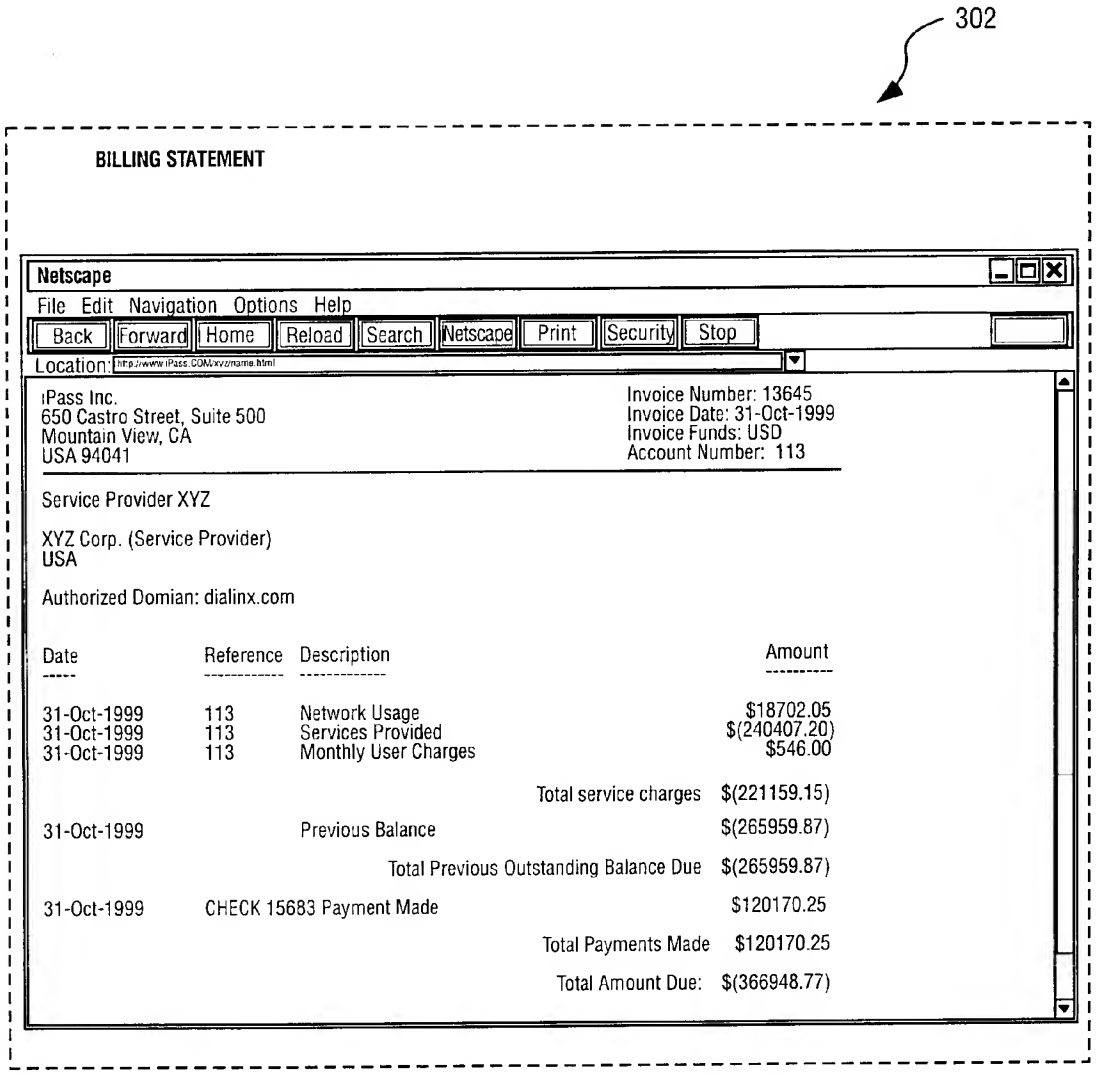
302
BILLING STATEMENT
Netscape
File Edit Navigation Options Help
Back Forward Home Reload Search Netscape Print Security Stop
Location: http://www.iPass.COM/xyz/name.html
iPass Inc.
650 Castro Street, Suite 500
Mountain View, CA
USA 94041
Invoice Number: 13645
Invoice Date: 31-Oct-1999
Invoice Funds: USD
Account Number: 113
Service Provider XYZ
XYZ Corp. (Service Provider)
USA
Authorized Domian: dialinx.com
Date Reference Description Amount
31-Oct-1999 113 Network Usage $18702.05
31-Oct-1999 113 Services Provided $(240407.20)
31-Oct-1999 113 Monthly User Charges $546.00
Total service charges $(221159.15)
31-Oct-1999 Previous Balance $(265959.87)
Total Previous Outstanding Balance Due $(265959.87)
31-Oct-1999 CHECK 15683 Payment Made $120170.25
Total Payments Made $120170.25
Total Amount Due: $(366948.77)

FIG. 18

304

CONSUMER USAGE REPORT

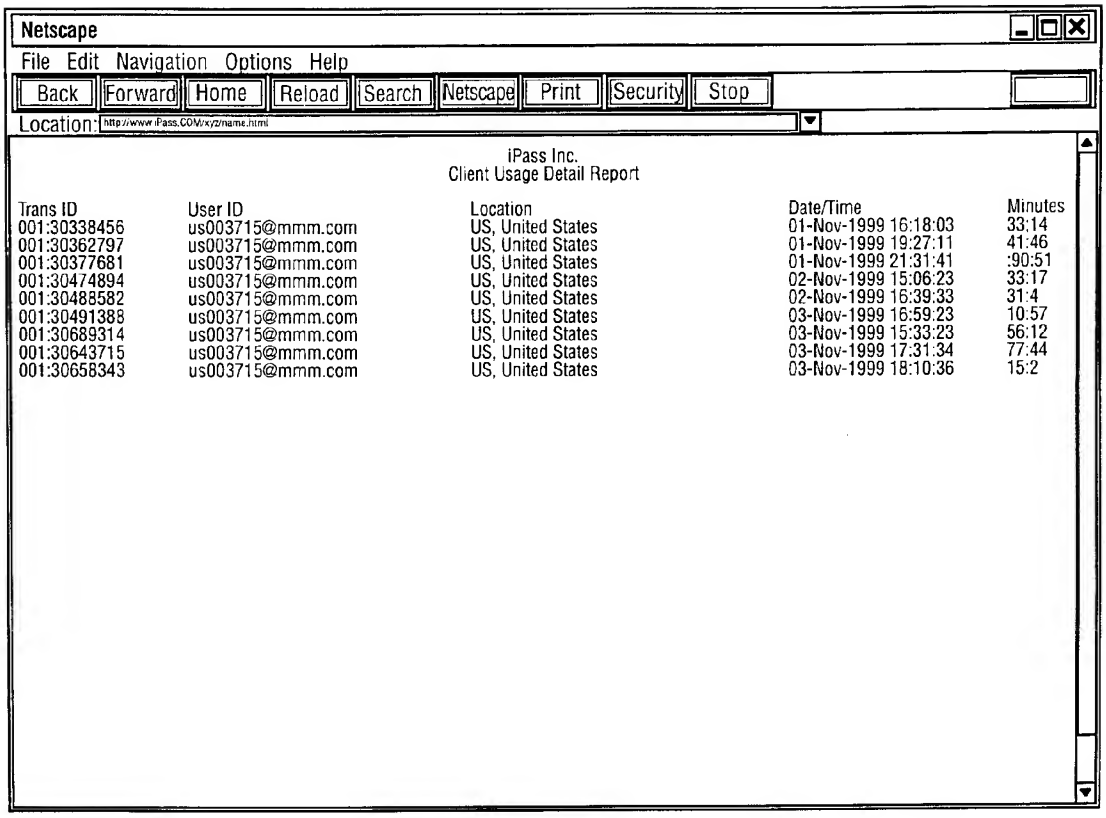

FIG. 19

306

SERVICE PROVIDED REPORT

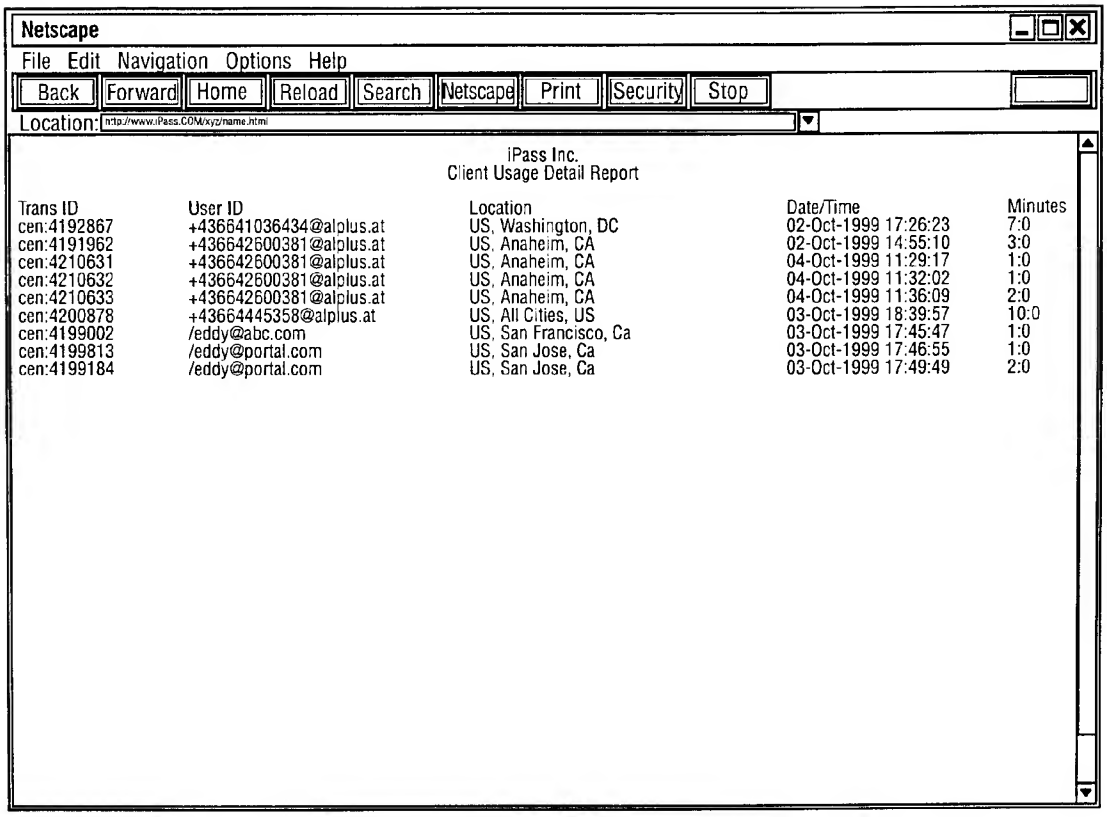

FIG. 20

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CDR REPORT

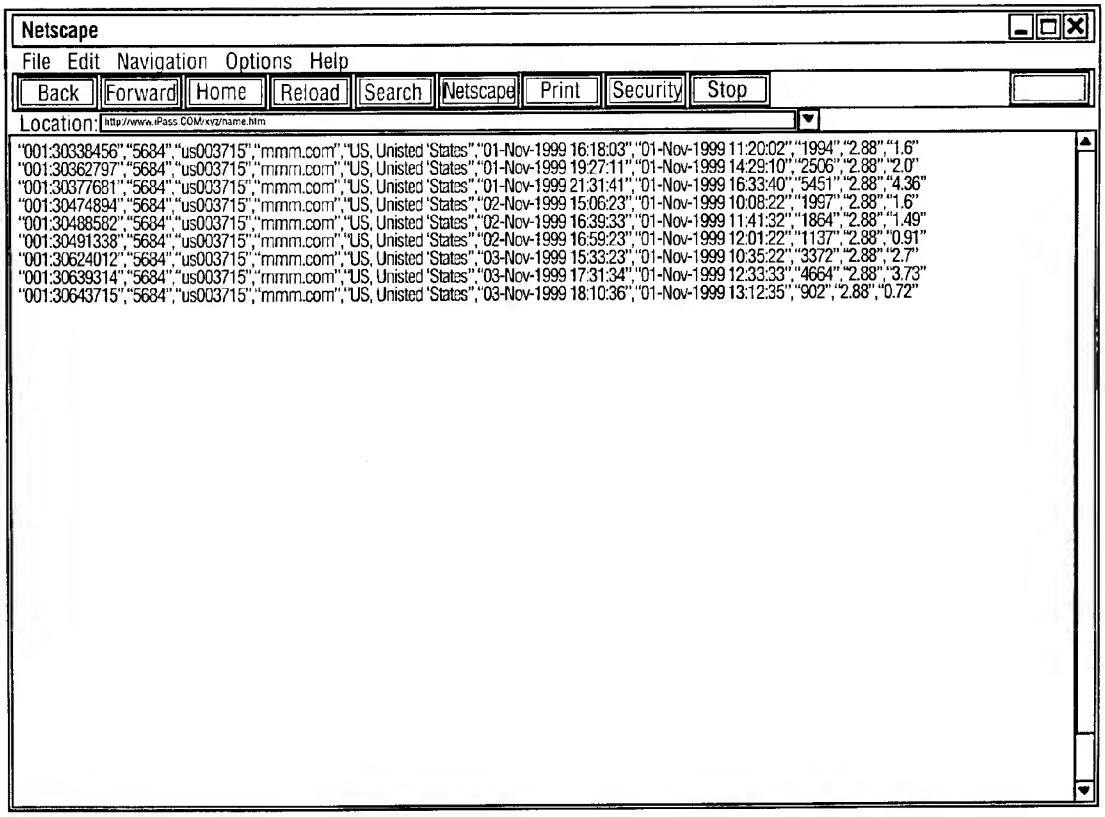

FIG. 21

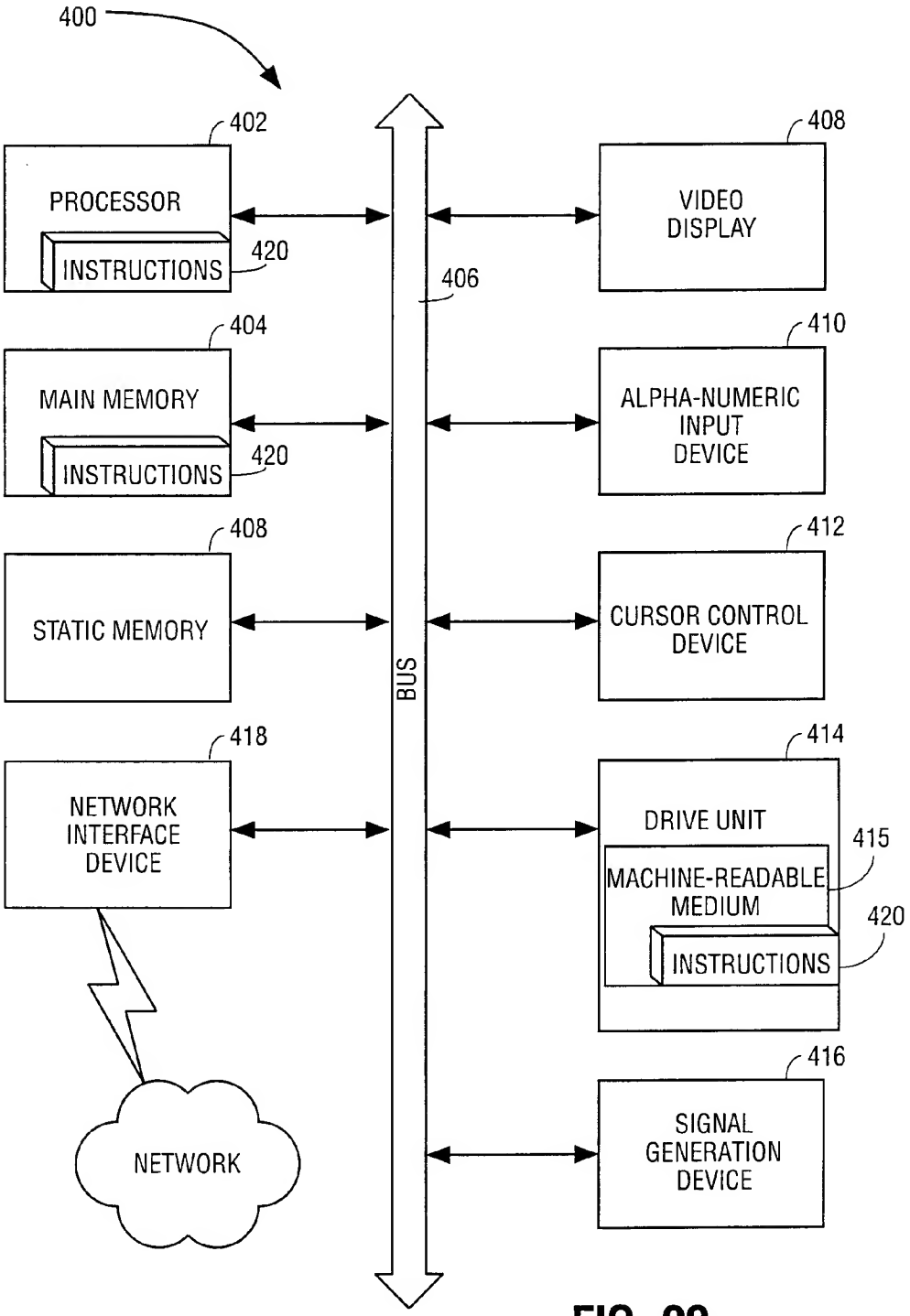
400
402
PROCESSOR
INSTRUCTIONS
420
404
MAIN MEMORY
INSTRUCTIONS
420
408
STATIC MEMORY
418
NETWORK INTERFACE DEVICE
NETWORK
BUS
406
408
VIDEO DISPLAY
410
ALPHA-NUMERIC INPUT DEVICE
412
CURSOR CONTROL DEVICE
414
DRIVE UNIT
415
MACHINE-READABLE MEDIUM
420
INSTRUCTIONS
416
SIGNAL GENERATION DEVICE

FIG. 22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/05752

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) :G06F 17/60
US CL :705/39
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/39

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,815,665 A (TEPER et al) 29 September 1998, see the entire document.	1-22

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 26 APRIL 2001	Date of mailing of the international search report 09 MAY 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 308-5401	Authorized officer Peggy Harrod WALTER MALINOWSKI Telephone No. (703) 308-3172

Form PCT/ISA/210 (second sheet) (July 1998) ★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/05752

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

EAST

search terms: internet, content, commerce, communications, service, access, sell, sold, sale, purchase, buy, service provider, isp